The American Journal of Surgery

EDITED BY THURSTON SCOTT WELTON, M.D.

August 1944

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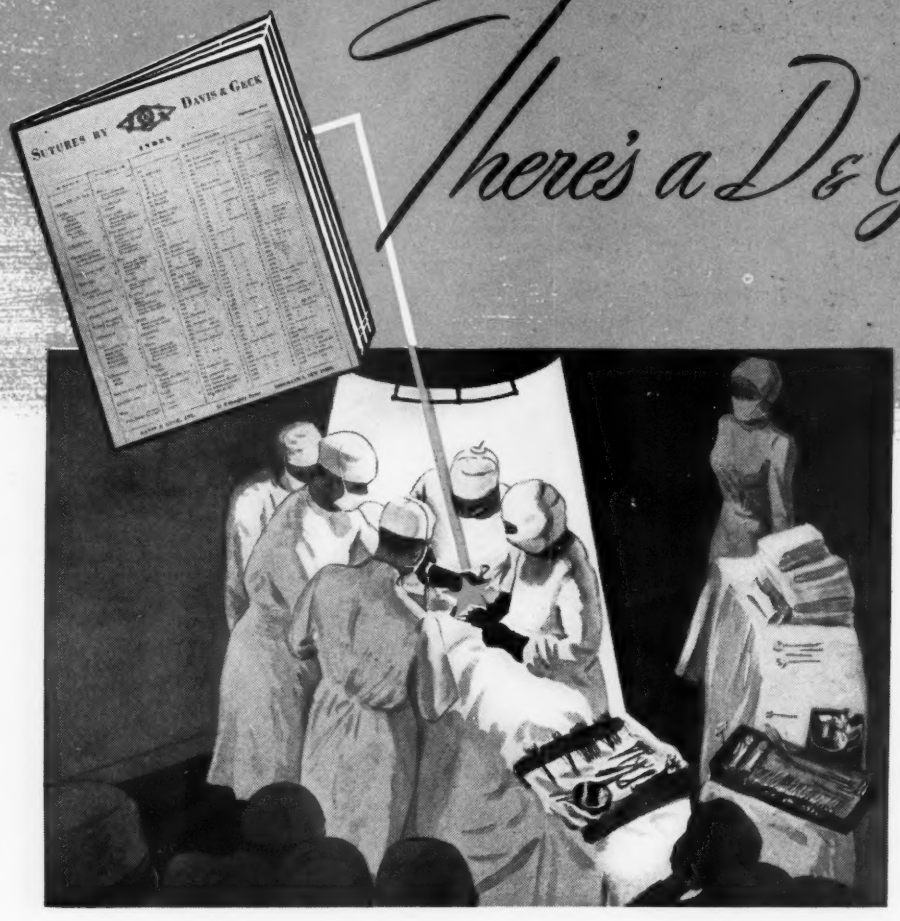

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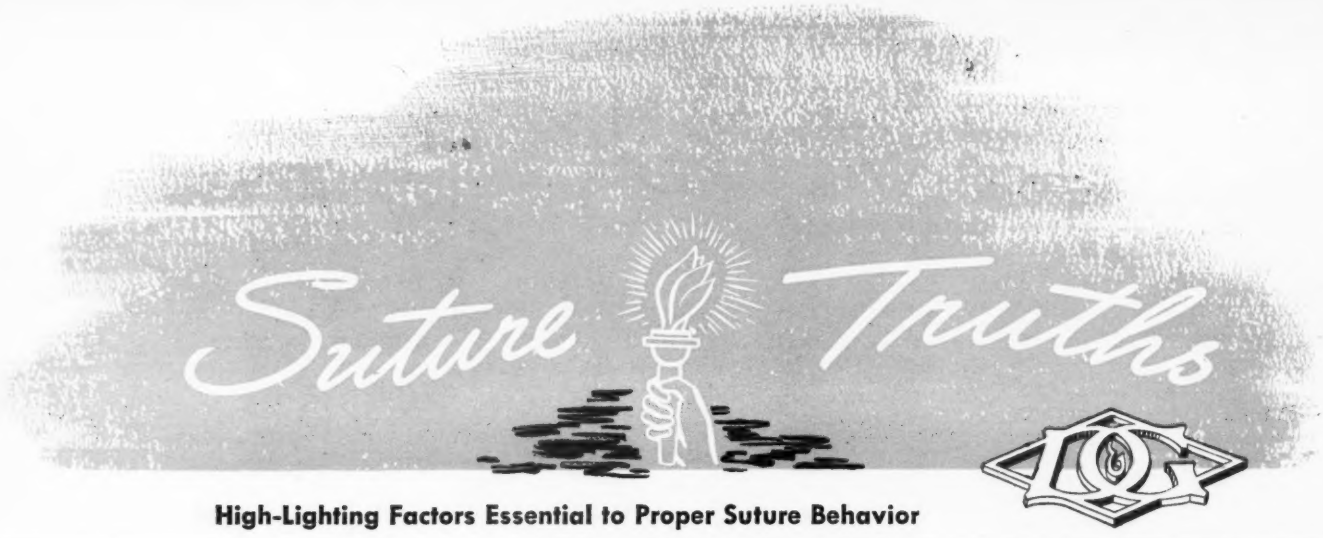

High-Lighting Factors Essential to Proper Suture Behavior

Control of Basic Materials Important to Suture Quality

In the making of sutures the highest standards of quality can be achieved and maintained only if careful control is exercised over the selection of basic materials. Especially is this true of catgut whose physical characteristics depend to a large degree on the quality of the animal tissue from which the strands are fabricated. Among the factors which must be rigidly controlled are:

1. Freshness. The structure and integrity of animal tissues are altered by bacterial action and likewise depreciated by use of chemical preservatives or freezing. Therefore, catgut of superior strength, flexibility and securely bonded ply structure can only be produced through use of fresh materials from recently killed animals.

2. Physiologic quality. Strength and uniformity of diameter are also improved by using only the "smooth" or outer curvature half of the first eight yards of the small intestines of animals free from pathogenic or dietectic conditions causing variance in wall thickness.

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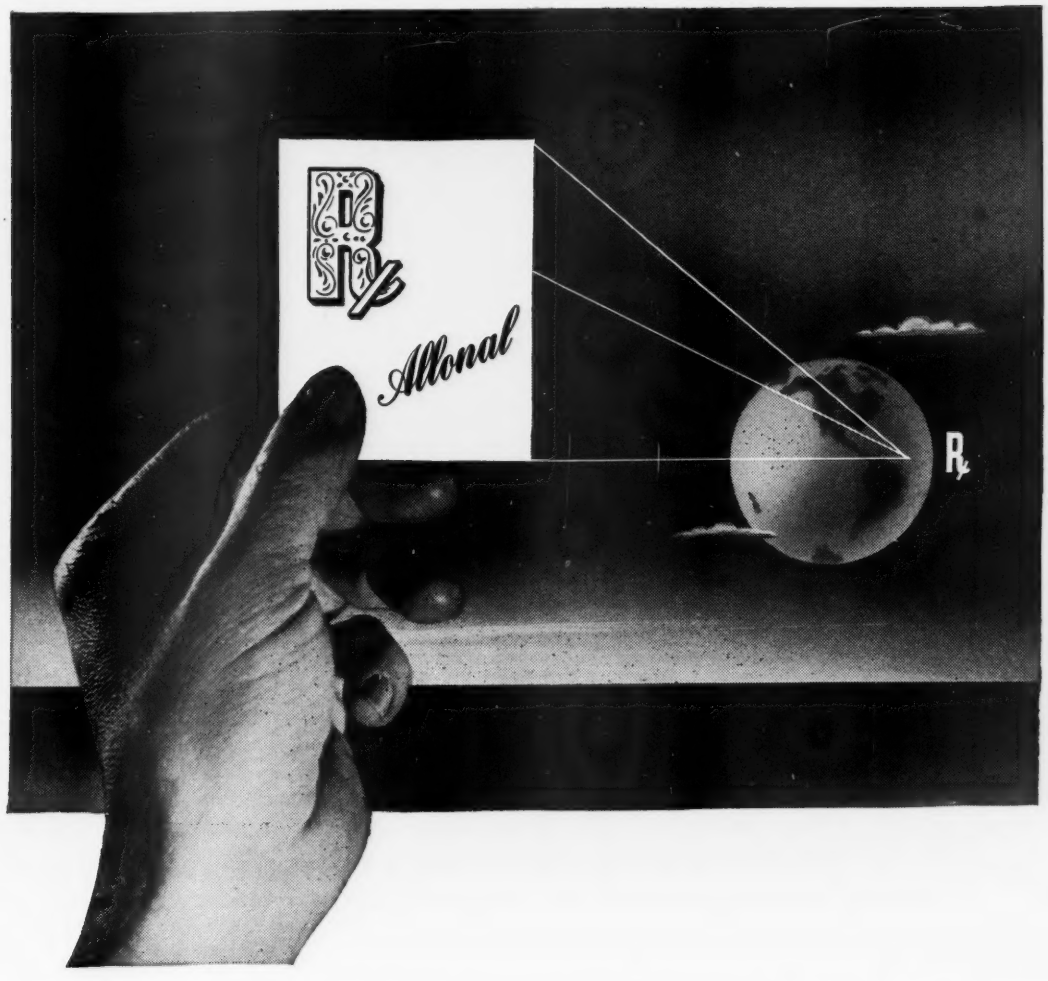

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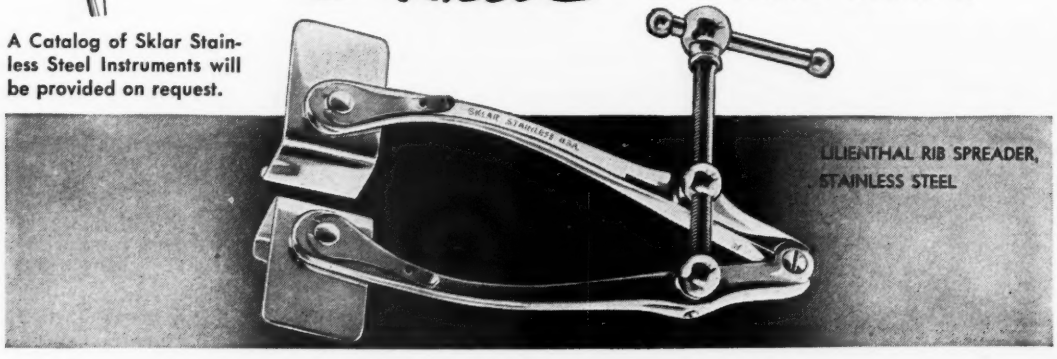

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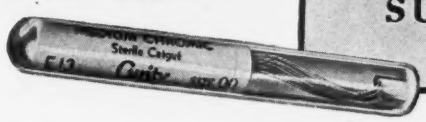

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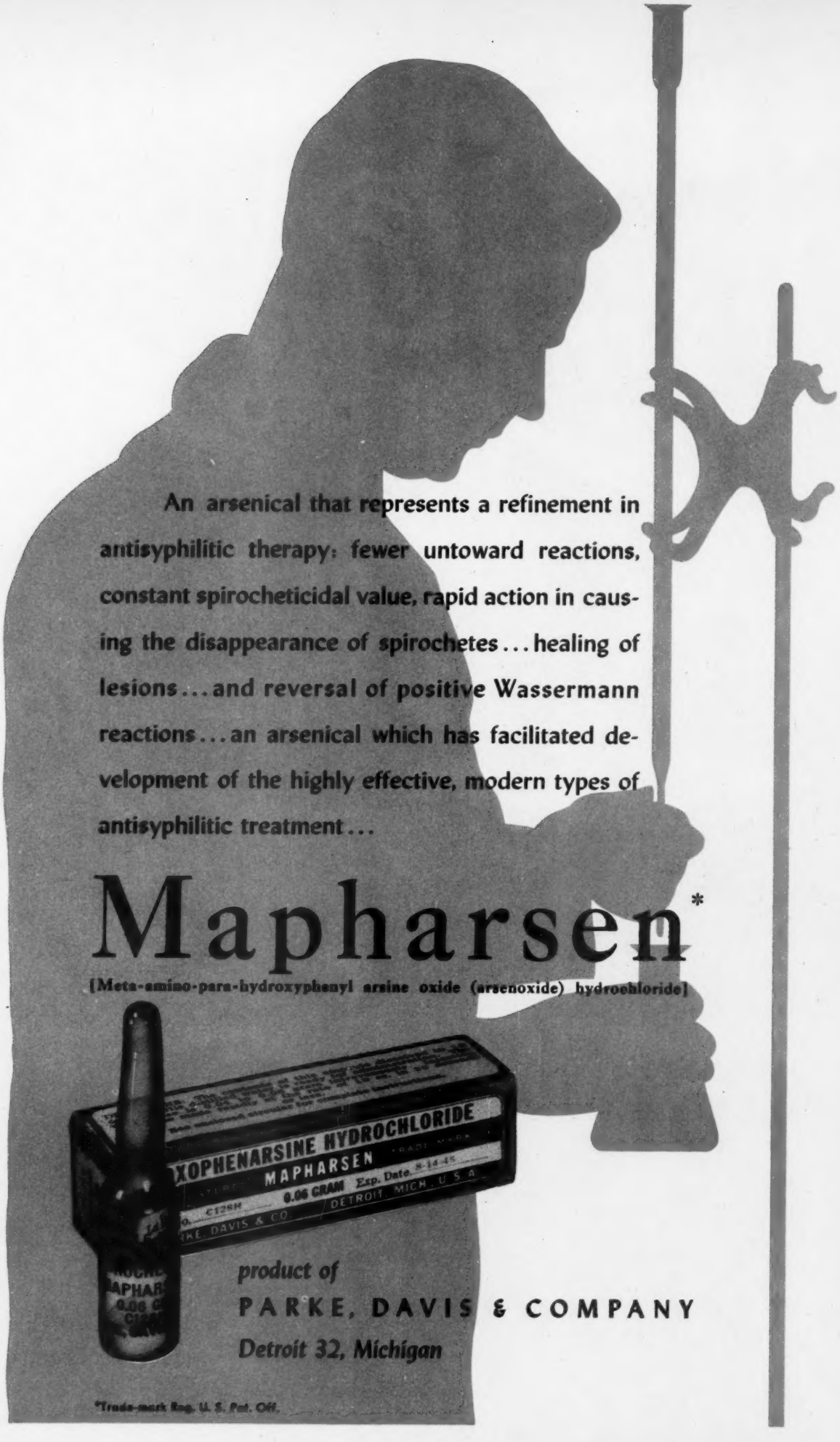

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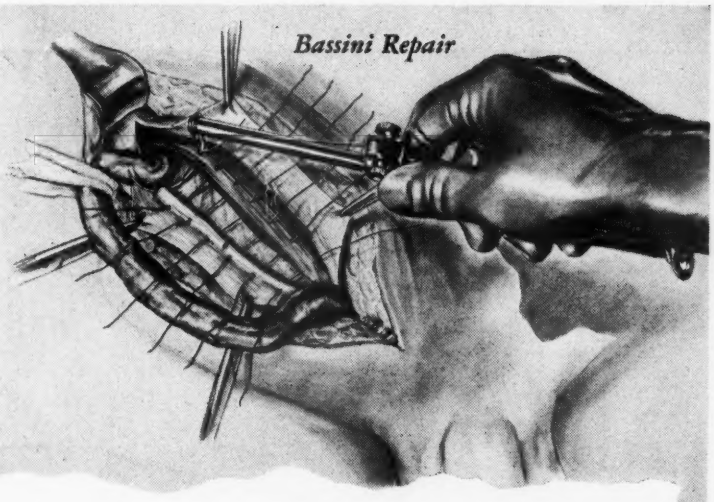

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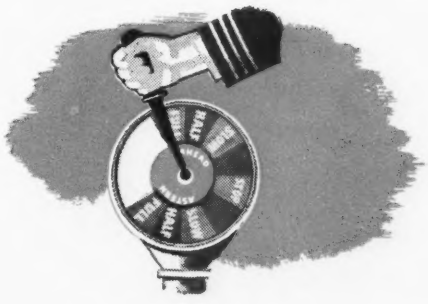

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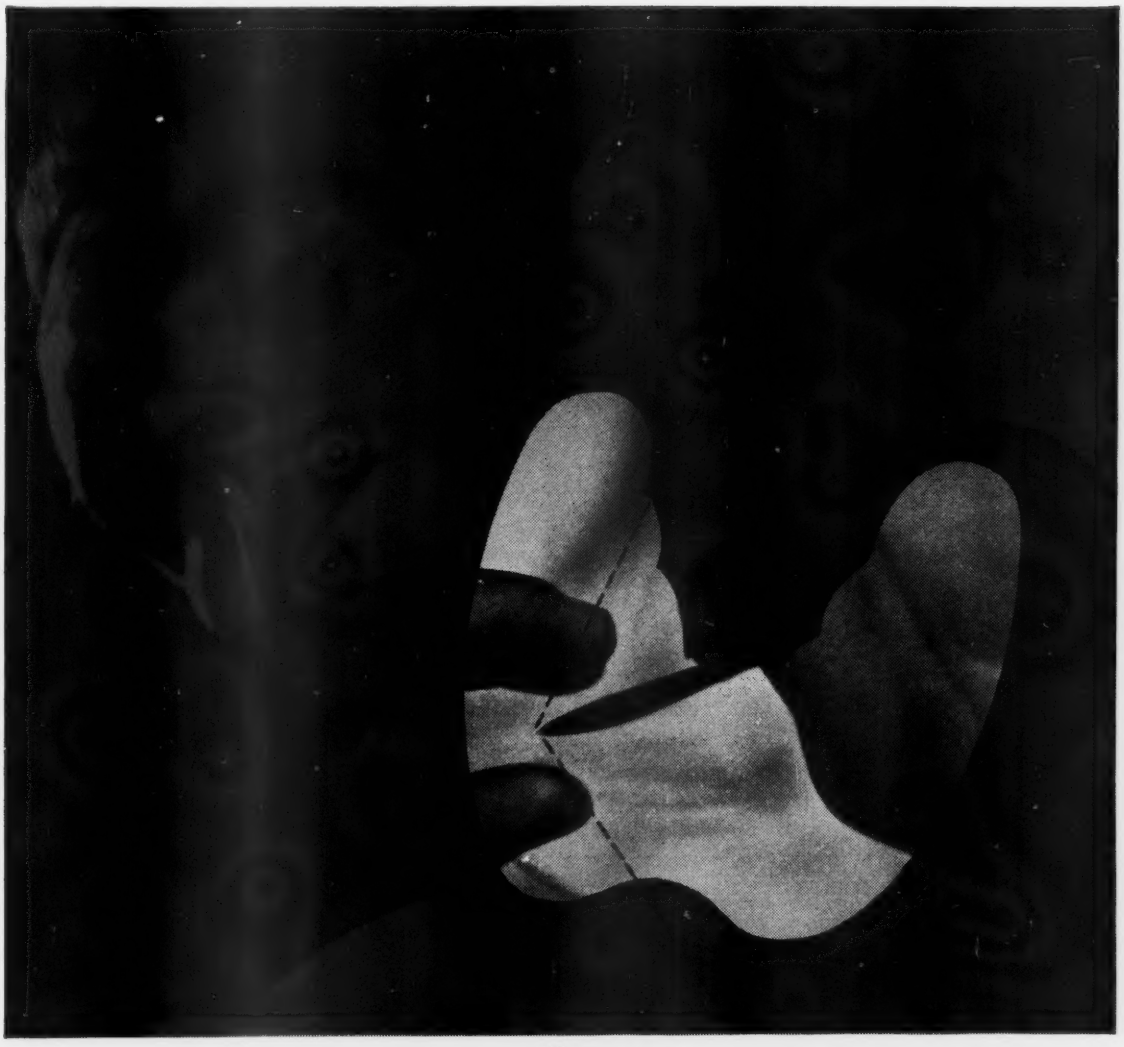

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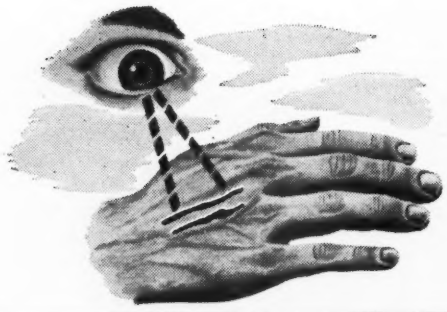

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*GOTTLIEB, R. Whole Liver as an Adjuvant to Iron in the Treatment of Hypochromic Anemia, Canad. M.A.J. 47: 456-460 (Nov.) 1942.

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The concentration withdrawn from the vial is 5000 units per cc. If a lower concentration is desired, modification is easily accomplished.

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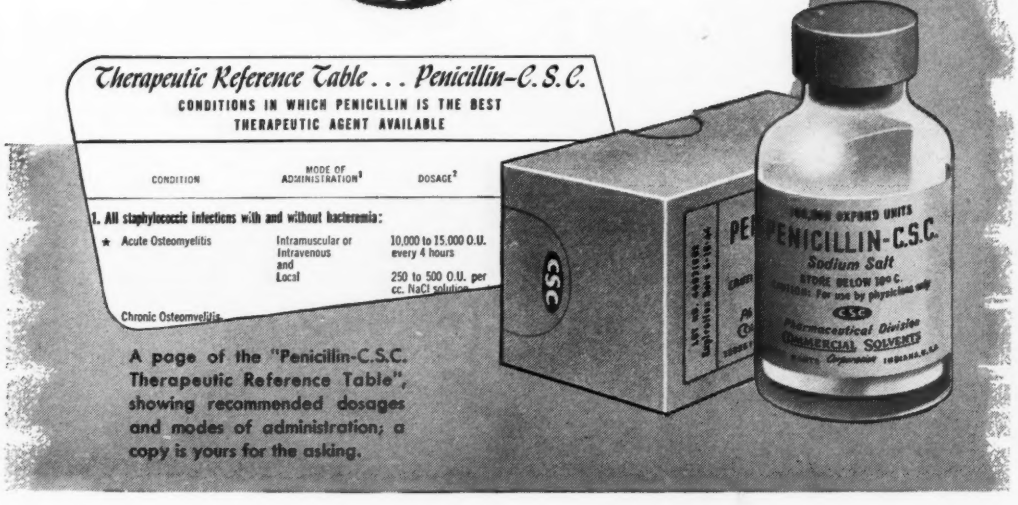

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Penicillin-C. S. C.—available as penicillin calcium as well as penicillin sodium—is packaged only in rubber-stoppered serum-type vials containing 100,000 Oxford Units. The vials are used in preference to sealed ampuls because they make for greater convenience in storing the solution and because they lessen the danger of contamination after the solution is made.

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The convenience of the vial will be readily appreciated. After removal of the tear-off portion of the aluminum seal, sterilize the exposed surface of the

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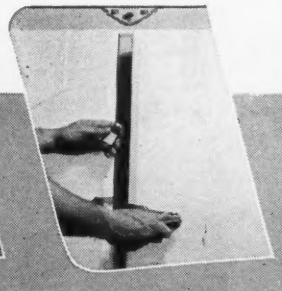
Invert the vial and syringe (with needle in vial), and withdraw the amount of penicillin solution required for the first injection.



Store vial with remainder of solution in refrigerator. Solution is ready for subsequent injections during the next 24 hours.

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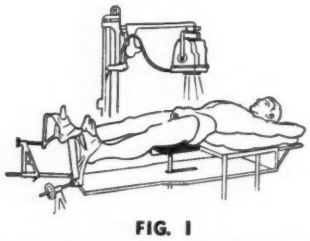

FIG. I

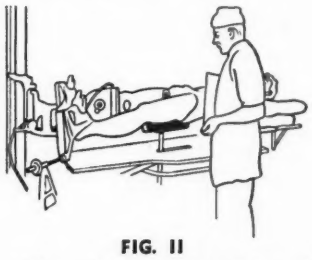

FIG. II

Fig. 1—*The anterior tube is centered over the greater trochanter.*
Fig. II—*Tube shifted from anterior to lateral position with center of tube in line with lateral x-ray director without moving either legs or disturbing drapes. Cassette Holder is placed in sterile pillow case and held very snugly above crest of the ilium directly opposite the opening of x-ray tube.*

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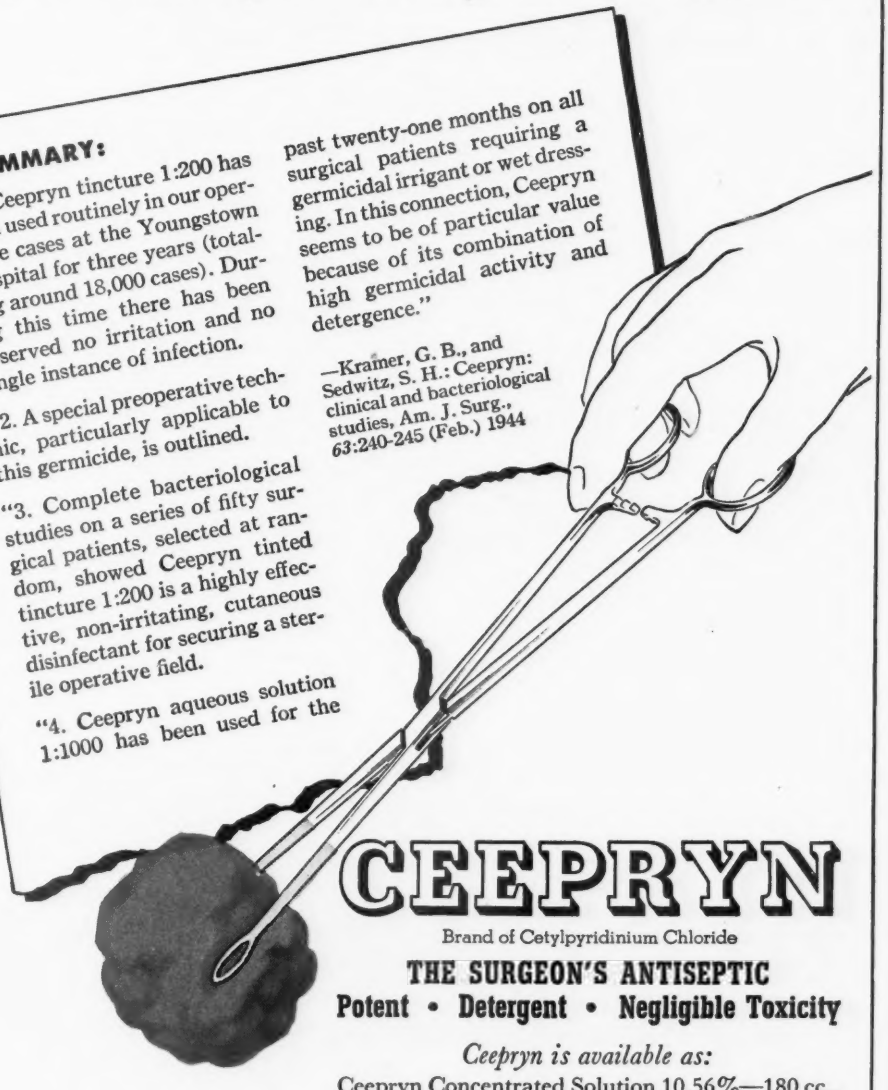
—Kramer, G. B., and Sedwitz, S. H.: Ceepryn: clinical and bacteriological studies, Am. J. Surg., *63*:240-245 (Feb.) 1944



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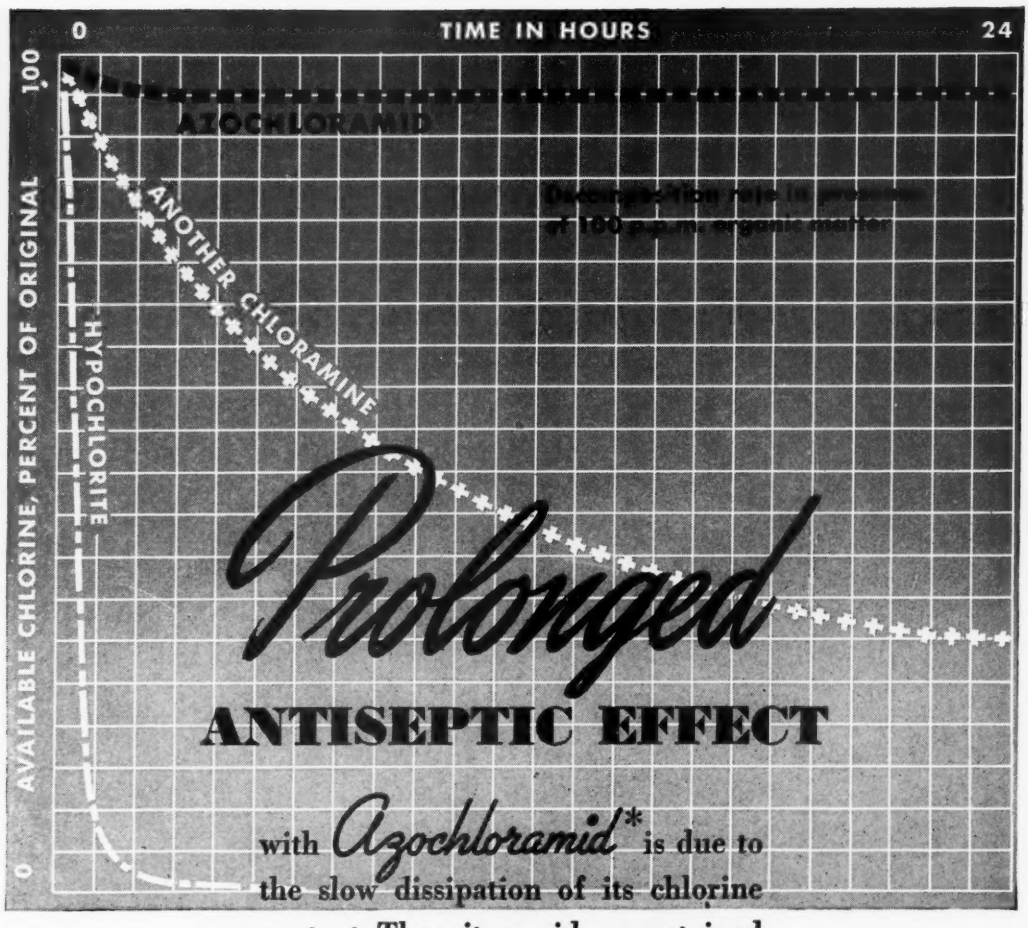

with *Azochloramid** is due to the slow dissipation of its chlorine content. Thus, it provides a sustained antiseptic action—*reducing frequency of dressings (and accompanying trauma) and resulting in conservation of time on the part of medical attendants.*

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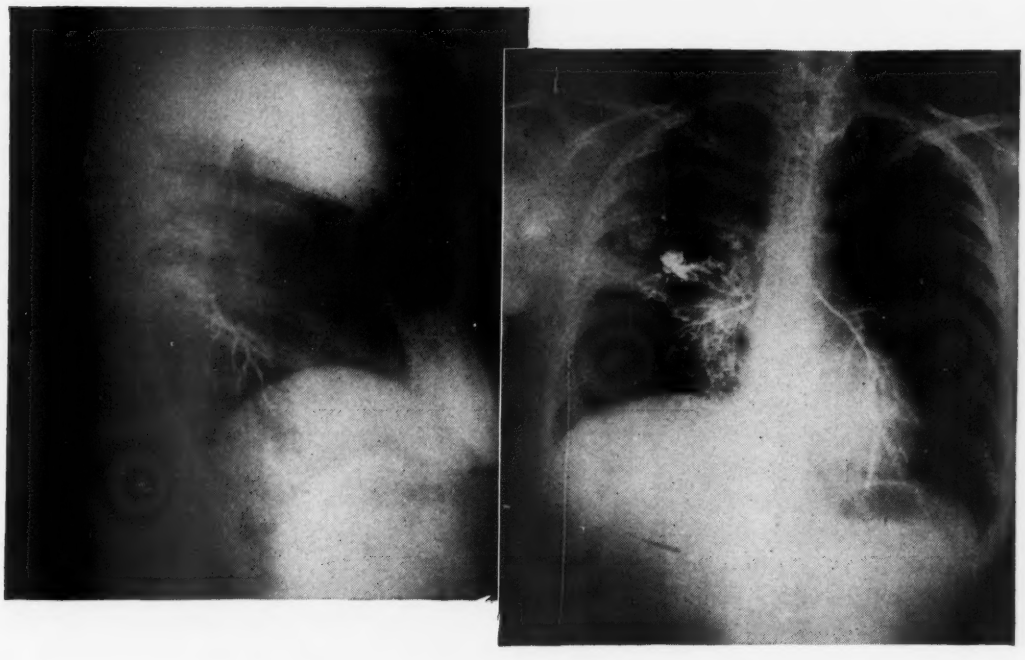

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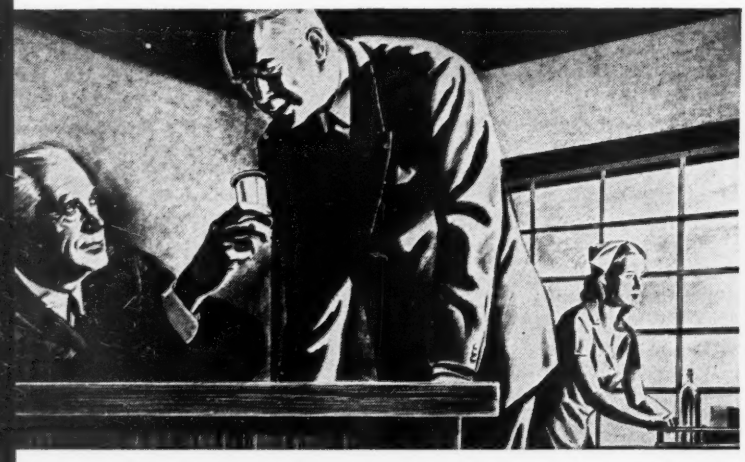
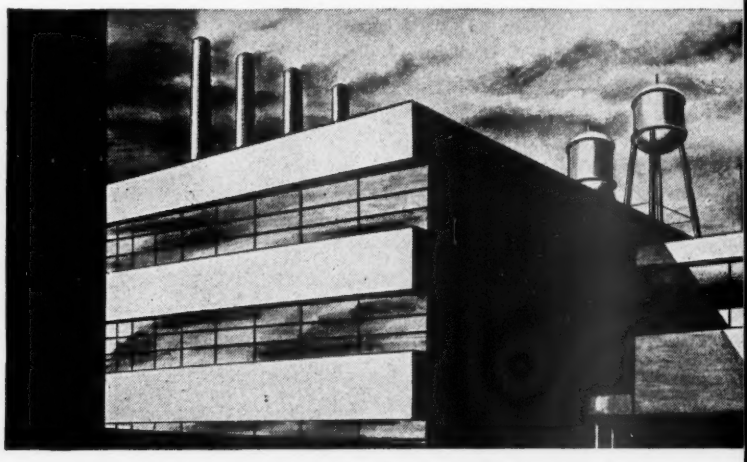
in 1937 . . . work began on the project. A synthetic adhesive was sought that would (1) have the proper adhesive qualities to stick to the skin, (2) that would age satisfactorily and prevent drying out on the shelf, and (3) would pass all allergy tests and be non-irritating to the skin.





in 1938 . . . such a synthetic adhesive was developed, perfected, and pronounced excellent. After experience with it, hospital physicians declared that it was as good in some respects, and in some ways *better* than crude rubber adhesives.

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Because . . . as a result of this foresighted research program, J & J synthetic adhesives have already been found satisfactory by many hospitals and doctors.

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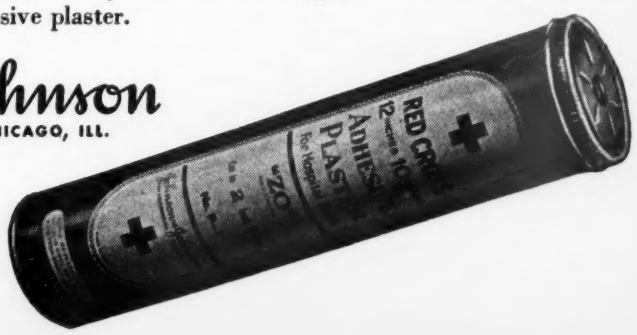

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NEW SERIES VOL. LXV AUGUST, 1944 NUMBER TWO

Editorial

APPENDICITIS IN THE TROPICS

EXPERIENCES IN A U. S. NAVAL BASE HOSPITAL

THE necessary emphasis on war wounds and tropical diseases at a large Base Hospital near the front, may make one forget such a common surgical condition as appendicitis. In the past year, at one of the Navy Base Hospitals in the South Pacific area 1,768 operations were performed; 316 were abdominal procedures and of these 41 per cent were for appendicitis. There was, therefore, an appendectomy performed every 2.8 days.

Appendicitis is by far the most common emergency condition requiring abdominal section, even in the war zone. While appendicitis may develop at any age, it is primarily a disease of adolescence. Fifty per cent occur between the age of five and twenty. The reason for the selectivity for this age is partly anatomical. After the age of forty, the appendix begins to atrophy and becomes obliterated. Up to the age of five, the appendix is relatively large in size and permits adequate drainage. The similarity of enviroment, food and types of infections results in a familial factor, many times members of the same family having operations for appendicitis. This applies also to men aboard ships or to troops in the field. During the time the Marines were training for both the Bougainville and Gilbert Island invasion, we had a high appendectomy rate. In each of those two months there were three times more operations for this condition than in any other month of the year. This increase was due to the temporary influx of young troops living under similar circumstances and dietary regimes.

All surgeons have noticed a difference in the severity of appendicitis in children and in adults. One-half of the appendices removed in infancy are ruptured. This diagnostic delay is partly due to children's inability to describe symptoms and the still prevalent idea of giving cathartics for so-called colics. Poor mastication of food and neglect of bowel habit also may be a factor. There is also a difference in the rapidity of the pathological change in this condition in winter and in the summer. At home we have associated this difference with the fact that children are out of school, off schedule and consuming larger and various amounts of liquids. These may be important factors.

Appendicitis, at any rate, in the tropics, may run as rapid a course as it does in children in the summer at home. The soldier or sailor is young and often does not wish to complain, thus masking his symptoms. He fears to lose contact with his outfit and friends, to be left behind. He has been told about hookworm, dysentery and malaria, all of which have abdominal

symptoms; and he may assume the abdominal discomfort is due to one of these. With the heat and humidity a large quantity of liquids, such as, cold drinks, beer, carbonated waters, and fruit juices of all types, are taken, all of which have the effect of increasing peristalsis. At rare times, irregularity of eating may have an effect. In many, the promiscuity of the toilet causes the development of a chronic constipation. All or any combination of these factors may be the answer, but we have been aware that appendicitis in the tropics is more severe, more rapid in its progress and with a greater tendency to gangrene than in other climates. Some of the difficulties in diagnosis will be enumerated.

The diagnosis of appendicitis can be made by the history. If it is typical, appendectomy is indicated. Even if it is not typical, appendicitis cannot be eliminated. The typical history, as described by J. B. Murphy, is a colicky pain of a general, epigastric or naval type followed by nausea, the nausea frequently resulting in vomiting one or more times. Localization later will occur in the right lower quadrant with tenderness. Murphy added fever to the above three, as a prerogative for diagnosis, but we will show that fever is not only not necessary but more often is absent. With such a history appendicitis will be correctly diagnosed in 95 per cent of the patients. A different history is usually due to previous attacks. A typical history was given in 65 per cent of the last one hundred appendectomies performed here. Fifty-one per cent of our patients gave a history suggestive of a previous attack. Many of the other classical aids to the diagnosis are not applicable. *Constipation* accompanies appendicitis in the majority of instances but in the tropics this rule does not hold. One out of every five of our patients with appendicitis had diarrhea. The *temperature* rise of one to three degrees, which we expected, frequently is not seen. The average admission temperature of our patients was 97.3°F., only 10 per cent were above 99°F., and only 1 per cent had a high fever, 104°F. The pulse rate, frequently an excellent guide to infection inside the peritoneum, was not a diagnostic help. We have heard surgeons make the remark that if the pulse rate was not elevated the patient did not have appendicitis. The average pulse rate of one hundred patients, with appendicitis, on admission to this hospital, was seventy-seven and eighty-two of these patients had advanced appendiceal disease.

We have been impressed with the abnormal blood counts, especially the white counts that are reported in this area. Babcock states that in appendicitis the white count of 9 to 18,000 will be early and associated with a 70 to 85 per cent polymorphonuclear cells. The average count in these one hundred patients studied was 11,714. This seems high but the count of forty-three of the patients was below 10,000 and the few with counts of 20 to 25,000 raised the average. The percentage of segmented forms also was low, the average being 58.5 per cent in contrast to the expected 80 per cent. This figure, though actually low, is relatively a mild increase as the percentage of segmented forms in a control group was 54. The number of band forms which averaged 6.5 per cent gave some indication of the activity of the process. It is apparent then, that the laboratory is even less helpful to us here in diagnosing appendicitis than it is in the States.

In analyzing the degree of severity of the disease we found 5 per cent were ruptured, 41 per cent were gangrenous, 39 per cent were acutely inflamed and only 15 per cent were considered mildly or chronically inflamed. This finding of nearly one-half, either ruptured or in a pre-ruptured state, argues, if any argument is needed, against procrastination for more diagnostic data. Delay is still our greatest problem. Perhaps more emphasis should be placed on training of both the servicemen and the corpsmen to be on the watch for appendiceal symptoms. The best opportunity of obtaining the patients for operation early should be in men under military discipline. Yet our patients were seen on

the average of twenty-seven hours after the onset of the symptoms; 51 per cent were seen over twenty-four hours after the symptoms began and 31 per cent only after forty-eight hours had elapsed. This figure should have been materially lower and perhaps could be decreased by correct instruction. At times, transportation and weather interfered with early operation and a few were seen where operation had been delayed at sea. Thirty-two per cent were seen in the first twelve hours and this compares favorably with the one-third seen in the first twelve hours in the report on appendicitis in a U. S. Hospital.

The desire to avoid delay does not mean that appendectomy by untrained men is preferable. Where conditions or personnel are not ideal for appendectomy, the Ochsner type of treatment with the addition of sulfa drug is indicated. Occasionally, of course, a normal appendix will be removed for gastro-enteritis or renal colic. If the appendectomy is performed by a trained man, there will be no ill effects from such a procedure in 299 out of 300 times. The effect of the error in judgment on the other hand, of course, would be serious. The man with pain in his right side should be considered to have appendicitis until proved otherwise. There were no deaths in this series.

Certain technical points in the operation for appendicitis are interesting. To most of us in private practice, spinal anesthesia is the anesthetic of choice, and in the service it is used practically exclusively. It was used 625 times in the past year at this base. It is rapid, safe (one death in over 7,000) and by producing a negative intra-abdominal pressure, eases the technical removal of the organ. The second anesthetic choice should be local infiltration. Five hundred seventy-four operations, of all types, were performed here in a year with this method. A local anesthetic is ideal if the anatomy of the area is kept in mind and if it is remembered that only that part injected is numbed. One cannot "hit" the patient with instruments, pull roughly on mesentery not infiltrated, or use rough or coarse instruments. A gentle technic is necessary for a local anesthesia success. Art as well as science is helpful in both local and spinal anesthesia and is worthy of a note. The patient is awake, apprehensive, and aware of all words and actions of the operating team. The comfort and lack of pain of the remainder of the body must be observed. Cramped and uncomfortable positions must be avoided. Pressure from instruments or the assistant's hands must be eliminated. Tension on or torsion of organs innervated beyond the anesthetic zone must be avoided. An entirely different technic stressing gentleness, smaller and more delicate instruments, needles and sutures and most important of all, the light hand, must be developed. This regime must be extended from the operator to every assistant or nurse. A general anesthetic frequently creates a false sense of security, even, of roughness and obtuseness in the operating room. The fact that the patient is unconscious permits even levity at times and strict discipline frequently relaxes when the difficult technical part of the operation is completed. In the use of local or spinal anesthesia, no such situation can endure. Shop talk, rough, though surgical language increases the already high degree of apprehension, and the banging and brandishing of instruments may play their part in destroying the cooperation of the patient on which surgical success depends. The use of music in the operating room to distract the patient has a sound psychological basis. A considerate voiced individual at the head of the table, who reassures the patient, is also of value.

In the service it is difficult to see much use for an inhalation anesthetic, and certainly in the tropics these other two should be sufficient in the great majority of instances. Of the others, sodium pentothal is more effective than ether, especially in the tropics. Four hundred thirty-seven intravenous anesthetics were given last year. Inhalation gasses have not been available in this area.

The muscle splitting incision of McBurney or others will be effective in most

cases. A transverse skin incision in the line of skin cleavage improves the scar. Personally, we found it better to place the incision higher than the classical site because the difficult appendix is usually the high and retroceal one. Further, the incision can be extended down better than up. When there is a diagnostic doubt, the right rectus incision is used. The so-called adequate incision (meaning large) and the small incision have their advocates. If the diagnosis is correct and it is possible to remove the appendix through an inch incision, we believe the patients do better, mainly because a small incision precludes the handling of the organs and spreading of the localized process.

The same difference of opinion exists between the inverters and the non-inverters of the stump, although we believe now that most surgeons do not invert. Cultures of the needles used to invert the appendix base will grow colon bacilli in 30 per cent. It follows that unless there is gross contamination, the peritoneum is able to care for the mild infection. Technic can make this contamination minimal. Care in retracting can prevent the stump touching the viscera or wound edge until the cautery and the tying of an adjacent piece of mesentery over the stump effectively seals it off. The changing of retractors and instruments in closing, from those used in removing the appendix is a minor point which helps prevent contamination.

When to drain is still a problem to many. The advent of sulfa drugs brought certain ill prepared publications which confused the picture. Certainly, clear or turbid fluid requires no drainage. Gross fecal contamination, on the other hand, is an indication for drainage, as even large doses of sulfa cannot counteract feces in the peritoneum. A safe plan is to drain if there has been perforation or gross contamination, but not to drain if there is merely a exudative reaction. In other words, when the fluid is exudative and protective do not remove it; when it is a contamination, drain it.

In 37 per cent of our patients there was free fluid in the peritoneal cavity. Sulfa powder was inserted 23 times, and these with few exceptions, were in the more advanced state. The function of the sulfa powder locally is debatable. It probably acts by absorption as a very high level can be obtained early. Its presence, locally, does cause some exudate and perhaps its intraperitoneal application thus increases the local protection power.

If a drain is placed in the wound, it should be to the base of the appendix. Drains into the pelvis, etc., merely help fix an abscess and the abscess thus may be the result of the drain.

One other debatable point is whether and when to feed the patient. When the peritoneum is opened there is at least a temporary insult to the contents. Nature counteracts this by creating a temporary ileus—a process to permit localization of any inflammation. Immobilization of any inflamed part is a keynote in aiding localization. When localization is no longer needed, peristalsis becomes active. Efforts to cause peristalsis prior to the time it would occur spontaneously can have detrimental effects. Thus feeding too early, or the use of such stimulants as prostigmine can upset the balance between the resistance and the infection. The distention which is present can best be controlled by suction siphonage applied to an indwelling duodenal tube.

We conclude, therefore, that right-sided abdominal pain or tenderness should be considered appendicitis until proven otherwise. In the tropics appendicitis often is a more rapid and severe disease than in other climates. The history and right lower quadrant tenderness is the best diagnostic aid. The laboratory methods of diagnosis in this disease are not reliable. Spinal anesthesia is the anesthetic of choice; local infiltration is also of value. There is still too much delay between the onset of symptoms and appendectomy. Sulfa drugs, etc., will not replace judicious surgery, and when in doubt—operate.

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Original Articles

FUNCTIONAL PARATHYROID TUMORS AND HYPERPARATHYROIDISM

CLINICAL AND PATHOLOGIC CONSIDERATIONS

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SECTION I. CLINICAL CONSIDERATIONS

REVIEW OF THE DEVELOPMENT OF THE CLINICAL CONCEPT OF HYPERPARATHYROIDISM

ACCORDING to Denninger, osteitis fibrosa cystica existed in America in pre-Columbian times. The skeleton of a primitive American, unearthed in northern Illinois, revealed lesions which have been interpreted as those of this condition.

In 1877, Paget called attention to the disease which has since borne his name. This disease is characterized by the thickening and bending of bones of persons of middle and old age. In 1891, von Recklinghausen confounded Paget's disease of bone with osteitis fibrosa cystica generalisata by taking up the two conditions as subtypes of a common fibrocystic osteitis. However, the description of his Cases 5 and 7 was the first really valuable anatomic account of this disease of bone.

In 1904, Askanazy described the association of disease of bone with a tumor of parathyroid origin. Askanazy stated the disease of bone to be osteitis deformans but his description clearly showed it to be the generalized type of osteitis fibrosa cystica. This isolated observation attracted little attention. In 1907, Erdheim[26] described three cases of osteomalacia associated with parathyroid enlargement. This called forth many other observations of disease of bone associated either with hyperplasia or with formation of tumor in the parathyroid glands.

The teachings of Erdheim delayed the clinical recognition of the etiologic rôle of parathyroid tumors in generalized osteitis fibrosa cystica. However, in 1915 Schlagenhaufer, after finding at necropsy two cases of generalized osteitis fibrosa cystica associated with tumorous parathyroid glands, questioned Erdheim's hypothesis as to the compensatory character of the enlarged parathyroid glands and recommended exploration of the neck and removal of the parathyroid tumor, if found.

In 1925, Hoffheinz reviewed from the literature forty-five cases of enlarged parathyroid glands. Of the twenty-seven which were associated with disease of bone, seventeen showed generalized osteitis fibrosa cystica, eight showed osteomalacia and two showed rickets.

In spite of Schlagenhaufer's suggestion, it was not until 1926 that Mandl,[50] of Vienna, resorted to exploration of the parathyroid region in a case of generalized osteitis fibrosa cystica. He did this only when treatment by parathyroid transplants had failed. A parathyroid tumor was found and removed at operation. Considerable clinical improvement followed this operation but recovery was incomplete. Seven

years later further lesions of bone and renal stones had developed. Mandl[51] reoperated but was unable to find further tumor tissue which he believed to be present.

Following Mandl's report, interest in the surgical treatment of hyperparathyroidism was aroused. In 1928, Gold reported a case in which hyperparathyroidism was treated successfully by removal of a parathyroid adenoma. The patient was a woman aged fifty-four years, who had generalized osteitis fibrosa cystica. There were cysts in the right humerus and in three ribs, and the left femur had fractured. The concentration of calcium was 13.1 mg. per 100 cc. of serum and there was increased excretion of calcium in the urine. A parathyroid adenoma was removed. Five months later, there were considerable clinical improvement and much less pain. The concentration of calcium was 9.6 mg. per 100 cc. of serum and there was a positive calcium balance.

In 1929, Barr, Bulger and Dixon[13] were the first in America to report a case in which osteitis fibrosa cystica was treated by operative removal of a parathyroid tumor. The patient was a woman, fifty-six years of age, who had giant-cell tumors of the maxilla, ulna and right forefinger and a spontaneous fracture of the clavicle. There was muscular hypotonia. Bilateral renal calculi were present and there was increased frequency of micturition. The concentration of calcium was 16 mg. per 100 cc. of serum and that of phosphorus was 1.4 mg. per 100 cc. of serum. Excretion of calcium in the urine was greatly increased. In the left lobe of the thyroid gland a globular mass the size of a walnut could be felt. A parathyroid adenoma was removed and two days after operation, tetany developed. The calcium balance became positive and the concentration of calcium fell to as low as 4.1 mg. per 100 cc. of serum on the sixteenth postoperative day, while that of phosphorus rose to as high as 11.2 mg. per 100 cc. of serum on the ninth postoperative day. Unfortunately, the patient later died with infection of the urinary tract and impaired renal function.

In 1905, MacCallum was the first to record the association of renal disease and a parathyroid tumor. His patient, a young man, died of uremia following nephritis. A parathyroid tumor was found at necropsy. In 1921, Hubbard and Wentworth reported a case of osteitis fibrosa cystica in which there were advanced interstitial nephritis and hyperplasia of the parathyroids.

The association of renal calculi and disease of bone was first noted by Davies-Colley in 1884. He described the case of a girl brought up in a cellar. A disease of her bones developed before the age of nine years. This was characterized by swellings in the jaw, ribs and pelvis which may well have been due to generalized osteitis fibrosa cystica. There were extensive calculi in the kidneys and ureters. Davies-Colley also noted in this case an increase of the urinary excretion of calcium and a decrease of the urinary excretion of the phosphate radical.

In 1907, Gaugele described a case of osteitis fibrosa cystica in which the patient died of uremia. The kidneys contained sand and stones which had produced hydronephrosis and pyelonephritis.

In 1912, Jacoby and Schroth found an abnormally high excretion of calcium associated with generalized osteitis fibrosa cystica. In 1926, Mandl[50] found that the increased excretion of calcium in the urine of his patient was reduced to a sixth of the preoperative level by removal of the parathyroid adenoma. Subsequent studies by Gold, by Wilder and by Boyd, Milgram and Stearns established an abnormally high excretion of calcium in the urine as a constant feature of the disease.

In 1928, Gold recorded the finding of an increased calcium content of the serum in his case of hyperparathyroidism. The subsequent reports of Wilder and of Boyd, Milgram and Stearns corroborated this finding. DuBois and Aub and Boyd, Milgram and Stearns were the first to record hypophosphatemia in clinical cases of hyperparathyroidism.

The cystic lesions of bone and the bony deformities of generalized osteitis fibrosa cystica were recognized by roentgenologic examination before their full significance in the pathologic picture of hyperparathyroidism was realized. However, in addition to the cystic lesions and deformities, Camp and Ochsner, in 1931, described a characteristic type of generalized osteoporosis encountered in some cases of hyperparathyroidism. The roentgenograms of the bones, particularly the skull, showed a miliary or granular appearance. The trabeculae of the bone and the cortical bone appeared thinned and regions of subperiosteal absorption were observed in the long bones and phalanges.

Changes in the mouth in diseases of the parathyroid glands were first recorded in 1906 by Erdheim[25] in his early observations on the effect of these glands on the teeth. In 1934, Albright, Aub and Bauer[3] described the changes in the mouth in the case of the famous Captain Martell. This patient was known to have had hyperparathyroidism for thirteen years and underwent seven operations before the parathyroid tumor was located in the anterior mediastinum. The jaws were in marked malocclusion. The lower jaw was prognathous to such an extent that the entire mandibular dentition was in mesial occlusion. Several visible masses distorted the normal contour of the alveolar process. Roentgenograms revealed numerous punched-out regions resembling cysts. The entire mandible was osteoporotic and in sharp contrast to the well calcified teeth. The trabeculation of the mandible and maxilla was closely meshed and similar to ground glass in appearance. The lamina dura was absent from almost all the teeth. Despite this, roentgenographic examination revealed only one or two obvious cavities. The history revealed that in the patient's numerous stays in the hospital for thirteen years his dental attention had been limited to one or two temporary fillings and that his occlusion had been normal fifteen years earlier. The teeth were not loose and a specimen tooth was extracted only with considerable effort.

In 1941, Strock reported his study of the changes in the mouth in forty-five cases of hyperparathyroidism. He found tumors of the jaw in about half the cases. Prognathism, malocclusion and the formation of cyst-like cavities in the jaw were common. Roentgenograms frequently revealed osteoporosis and a ground glass appearance of the jaws. Dental caries was unusual and this in spite of the increased calcium excretion of hyperparathyroidism. To Strock the most striking finding, one for which he thought every dentist should be on the watch, was absence or partial loss of the lamina dura as seen in roentgenograms.

Since Mandl's report in 1926, there have been many reports of cases of hyperparathyroidism. In most of these cases the etiologic factor has been formation of tumor in the parathyroid. In other cases hyperparathyroidism has been attributed to parathyroid hyperplasia. In 1936, Wilder and Howell, accepting only cases in which the diagnosis of hyperparathyroidism was well substantiated, collected 135 cases reported since the date of Mandl's publication. However, in 1941, Cope was able to state that sixty cases of proved hyperparathyroidism had been encountered at the Massachusetts General Hospital alone. It has thus become possible to recognize different clinical types of hyperparathyroidism and the diagnosis can now be made without the classic picture of von Recklinghausen's disease of bone.

One clinical type has become known as acute hyperparathyroidism. This term has been applied to those severe cases in which acute fatal hyperparathyroidism, usually superimposed on the background of more chronic hyperparathyroidism, has developed.

In 1923, Dawson and Struthers gave the first clear account of an acute fatal illness in the course of a case which presented generalized osteitis fibrosa with parathyroid tumor and metastatic calcification. The terminal phenomenon was an

acute syncopal attack with a rapid, feeble pulse.

In 1932, Lowenburg and Ginsburg described the results of the administration of an excess of parathyroid hormone to a boy aged five years. He received 100 units a day in error. On the second day he began to vomit and became listless. On the fourth day extreme mental depression had developed and there were fever and tachycardia. These became more severe until on the sixth day the error was discovered. The concentration of calcium was then 19.6 mg. per 100 cc. of serum. Rapid recovery followed withdrawal of the drug.

In 1939, Hanes described a case in which there was a five-year history of hyperparathyroidism with changes of bone and metastatic renal calcification. While awaiting operation the patient became weak and mentally depressed, fever and tachycardia developed and she died before operation could be performed.

In 1939, Oliver described two cases of death from hyperparathyroidism. The prominent clinical features were vomiting, anorexia, loss of weight, asthenia, constipation, mental retardation and thoracic pain. Fever, drowsiness, tachycardia and elevation of the concentration of urea in the blood preceded death.

In 1940, Smith and Cooke described the fifth case of acute hyperparathyroidism to be confirmed by necropsy. The patient had a two-year history of limping, pains in the leg and constipation. Abdominal pain, vomiting and tachycardia then developed. Delirium, abdominal distention and elevation of the concentration of urea in the blood preceded death.

CASE REPORTS—CLINICAL

A study of the case records of the Mayo Clinic up to November, 1942, revealed fourteen cases of hyperparathyroidism due to formation of tumor in the parathyroid glands.* The cases have been numbered in the chronologic order of the appearance of the patients at the clinic.

Case 1. The clinical aspects of this case have been reported by Wilder and also by Rankin and Priestley. The pathologic features of the parathyroid tumor removed at operation have been described by Wellbrock. This was the second case in America in which a parathyroid tumor was removed for the relief of hyperparathyroidism. The patient was a woman, aged thirty-five years, who had been incapacitated for six years. The long history of anemia, pains in the legs, weakness, loss of weight, fatigability, tenderness of bone, and bone tumors of giant-cell type in the maxilla and generalized osteoporosis was at first considered to be due to a nutritional deficiency with osteoporosis and unexplained formation of giant-cell tumor; however, when the possibility of hyperparathyroidism was considered, following Barr, Bulger and Dixon's[13] report in 1929, the elevated concentration of calcium in the serum, the depressed concentration of phosphorus in the serum and the palpable tumor in the parathyroid region readily clinched the diagnosis. To complete the clinical picture a left renal calculus was discovered six months after the removal of the parathyroid tumor. Six years later, this calculus had to be removed on account of left renal colic. The patient died in 1940, and necropsy, performed by Dr. J. D. Edgar, of San Diego, California, revealed an epidermoid carcinoma of the upper end of the esophagus. There was no evidence of parathyroid tumor.

Case 11. This case has been reported by Pemberton and Geddie. A girl, aged fourteen years, presented the problem of a chronic wasting disease for investigation. Weakness, pallor, loss of weight, polyuria and spells of vomiting were the prominent features. The low fixed urinary specific gravity and the finding of a concentration of urea of 80 mg. per 100 cc. of blood suggested chronic glomerulonephritis. However, the roentgenologist reported the calvarium to show a fine mottled appearance suggesting an atypical form of metastasis or the changes found in some of the atypical leukemias. He suggested roentgenographic

* Since then at the clinic eleven cases have been discovered and the tumor has been removed. There are in addition four more cases in which for one reason or another the diagnosis has as yet not been confirmed surgically. This sudden apparent increase in incidence unquestionably reflects the keener diagnostic acumen that follows a high threshold of suspicion.

examination of the pelvis, spinal column and long bones. The long bones showed similar changes to those found in the skull with rarefaction, thinning of cortical bone and, in addition, localized regions of destruction in the right tibia and left ulna. The spinal column and pelvis were reported as showing the diffuse thickening of Paget's disease of the bone. These roentgenographic findings led to the investigation of the calcium metabolism. The concentration of calcium was found to be 17.7 mg. per 100 cc. of serum and that of phosphorus was depressed to 2.4 to 3.2 mg. per 100 cc. of serum. The calcium balance was negative. The diagnosis of hyperparathyroidism was made and a parathyroid tumor was successfully removed. Four years after operation roentgenograms revealed recalcification of the bones and six years after operation the patient's general health was reported to be good.

Case III. This case has been reported by Allan. A man, aged thirty-four years, complained chiefly of weakness in the legs and pains in the hips and knees. These conditions were of two years' duration. A neurologic lesion was suspected but after careful neurologic examination the weakness was considered to be of a muscular type and the pain in the hips and knees to be local. The patient complained also of severe thirst, considered typical of diabetes insipidus. A roentgenologic examination of the skull was made in the course of the neurologic examination, and the roentgenologist reported a fine miliary mottling of the skull. The changes were suggestive to him of hyperparathyroidism. He advised roentgenologic examinations of the spinal column, pelvis and long bones. These showed definite osteoporosis with diffuse granular mottling and multiple cystic regions characteristic of hyperparathyroidism. These findings led to the estimation of the values for serum calcium and serum phosphorus. The concentration of calcium was found to be elevated as high as 16.7 mg. per 100 cc. of serum and that of phosphorus depressed as low as 2.6 mg. per 100 cc. of serum. Further review of the patient's history revealed complaints of weakness, fatigability, indigestion, vomiting spells, loss of weight and rounding of the back. No parathyroid tumor was palpable but the diagnosis of hyperparathyroidism was made.

At operation, a parathyroid tumor was found and removed. On the third day after operation, symptoms and signs of tetany developed. These were controlled with calcium therapy. One year after operation, the patient stated that his general health was good. His weight had increased sixty-five pounds (29.5 kg.) and there was no polyuria. He was able to walk but still used crutches because of a feeling of instability. The right quadriceps tendon was found to have been avulsed from the tibia, allowing the patella to ascend into the thigh. The concentrations of calcium and phosphorus were 9 mg. and 2.3 mg. per 100 cc. of serum, respectively.

Case IV. This case has been reported by Wilder, Camp, Robertson and Adams and also by Rankin and Priestley. The patient was an unmarried woman, aged fifty years at the time of operation in 1932. She first came to the clinic in 1930 complaining of generalized weakness, stiffness in the knees and a pain in the back which extended down along the course of the sciatic nerves. She had been bedridden for two years. She was poorly nourished and anemic. Roentgenographic studies gave evidence of definite osteoporosis of practically all bones and the roentgenologist suggested the diagnosis of hyperparathyroidism. Repeated estimations of the concentration of calcium revealed values ranging from 8.6 to 10.1 mg. per 100 cc. of serum and the concentration of phosphorus ranged from 1.6 to 3.6 mg. per 100 cc. of serum. The clinical diagnosis of carcinomatous metastasis to bone was tentatively made and roentgen therapy instituted. The patient returned home and temporary improvement took place.

However, in 1932, she returned with the same complaints and, in addition, was suffering from severe intermittent cramps in the legs. Roentgenographic studies of the pelvis and spinal column gave evidence of considerable osteoporosis, which was considered indicative of hyperparathyroidism. There was a pathologic fracture of the left femur. The concentration of calcium ranged from 10.6 to 11.8 mg. and that of phosphorus from 2.3 to 3 mg. per 100 cc. of serum. The serum alkaline phosphatase value was 61.7 Bodansky units. A negative balance for calcium was demonstrated and although a tumor was not palpable in the neck the diagnosis of hyperparathyroidism was made and the neck was explored. A parathyroid tumor was found and removed. Following operation, the concentration of calcium fell as low as 5.5 mg. per 100 cc. of serum on the second postoperative day. Evidence of tetany developed. This was

controlled by the administration of calcium and a parathyroid extract. During the third postoperative week, severe nausea and vomiting developed, associated with meteorism and diarrhea. The patient gradually declined and died on the seventy-seventh postoperative day.

Case v. This case has been reported by Brown. A married woman, aged fifty-two years in 1935, first registered at the clinic in 1931, complaining of backache of seven years' duration. In the five years preceding registration, she had suffered from two attacks of left renal colic and one recent attack of right renal colic. A dull lumbar backache persisted between the attacks. She was found to have bilateral nephrolithiasis and right pelviolithotomy was performed, the stone being removed from the middle calix of the right kidney. Operation on the left kidney was deferred by the patient.

She returned in 1935, again complaining of pain in the left lumbar region. However, she also complained of pain in the region of the left shoulder and some aching in the knees. Shortly after leaving the clinic in 1931, she had had a traumatic fracture of the right arm, from which she had made a good recovery. She also complained of weakness and readily induced fatigue. She had noticed some increased thirst and polyuria. Hyperparathyroidism was suspected. Roentgenograms of the urinary tract revealed multiple regions of calcification or stones in the left kidney and some small indistinct shadows over the right kidney. There was osteoporosis of the spinal column and pelvis. In the roentgenograms of the thorax, a small soft tissue shadow could be discerned just below the right sternoclavicular joint. It was believed that this might be attributable to a parathyroid tumor. The concentration of urea was 36 mg. per 100 cc. of blood. The concentrations of calcium and phosphorus ranged from 14.7 to 15.3 mg. and from 2.0 to 2.6 mg. per 100 cc. of serum, respectively. The value for serum alkaline phosphatase ranged from 10.0 to 10.2 Bodansky units. The parathyroid region was explored and a parathyroid tumor removed. The concentration of calcium fell to 9.1 mg. per 100 cc. of serum on the third postoperative day, and mild symptoms of tetany developed. These were controlled with calcium therapy. Roentgenologic examination of the chest following removal of the parathyroid tumor revealed that the soft tissue shadow formerly visualized below the right sternoclavicular joint was no longer present.

Case vi. A woman, aged fifty-three years, registered at the clinic in June, 1935. She stated that in 1930 she had commenced to have pain between the shoulder blades. In 1932, she became stooped, pains developed in the arms and legs and she began to lose weight and feel weak. These symptoms gradually increased and five months before registration painful feet and swelling of the ankles developed. She denied any symptoms referable to the gastrointestinal or urinary tracts.

Her body weight was seventy-one pounds (32.2 kg.) and her height 4 feet 4 inches (132.1 cm.) and there were gross kyphosis and scoliosis of the thoracic segment of the spinal column. The concentration of hemoglobin was 13.3 Gm. per 100 cc. of blood and there were 4,120,000 erythrocytes per cubic millimeter of blood. The concentrations of calcium and of phosphorus were 11.6 mg. and 2.8 mg. per 100 cc. of serum, respectively. The value for serum alkaline phosphatase was 12.1 Bodansky units. On roentgenologic examination all bones showed changes characteristic of advanced hyperparathyroidism. There were multiple pathologic fractures of the ribs and marked kyphosis with compression of the thoracic vertebrae. The pelvis and the right humerus showed extensive fibrocystic changes and there were areas of calcification in the splenic region. The renal regions were negative for calculi.

Exploration of the parathyroid region was decided on. At operation a parathyroid tumor was found on the posterior aspect of the right lobe of the thyroid gland. This had not been palpable preoperatively. Following removal of the tumor the concentration of calcium dropped to 7.1 mg. per 100 cc. of serum on the third postoperative day and the patient complained of numbness and tinglings in the extremities. Seventeen days following operation the concentrations of calcium and phosphorus were 8.1 and 4.2 mg. per 100 cc. of serum, respectively, and the serum alkaline phosphatase value was 32.6 Bodansky units. Roentgenologic examination of the skeleton six weeks after operation revealed considerable recalcification. On dismissal there was no evidence of tetany and the patient felt well. She was advised to take cod liver oil and calcium lactate. She has not been heard from since.

Case vii. This case has been reported by Snell and discussed by Mayo. A man, aged forty-seven years, registered at the clinic in December, 1935. His home physician had

made a tentative diagnosis of hyperparathyroidism. In 1931, the patient had undergone nephrectomy because of right renal colic and a stone-filled right kidney. One year after this operation he noticed weakness and undue fatigability. In the early months of 1935 he consulted a physician regarding weakness and loss of weight. Marked anemia was discovered and treatment instituted without subjective improvement. Before coming to the clinic in 1935 he had failed rapidly with loss of weight, pain in the legs and weakness. He had lost 4½ inches (11.4 cm.) in height. He had also come to notice a mass in the right cervical region. This had grown rapidly and produced a sensation of choking.

When examined at the clinic the patient was weak, pale and in obvious pain. He had a round back deformity and a moderate degree of pes planus. A tumor was present in the lower right cervical region extending beneath the sternum. The shadow of this tumor was partially visible in roentgenograms of the thorax, displacing the trachea to the left. The average urinary output was found to be about 3 liters a day. Renal function, as measured by the urea and sulfate clearance tests, was greatly reduced. The urea clearance was 11 cc. and the sulfate clearance 6.2 cc. per minute. The concentrations of calcium and phosphorus were 14.9 mg. and 2.6 mg. per 100 cc. of serum, respectively, and the serum phosphatase level was 24 Bodansky units. Roentgenographic examination of the thorax revealed severe osteoporosis with multiple spontaneous fractures of ribs in addition to the large substernal mass. Roentgenograms of the long bones, pelvis and skull revealed the characteristic fine miliary osteoporosis of hyperparathyroidism.

The cervical tumor was explored and removed. It proved to be of parathyroid origin. Following operation the concentration of calcium fell rapidly to 7.8 mg. per 100 cc. of serum and the patient complained of a paresthesias in the fingers and toes. Moderate renal insufficiency with elevation of the concentration of urea to 78 mg. per 100 cc. of blood appeared postoperatively but this rapidly improved with the administration of fluid in large quantities. Seven months after operation his only complaint was of painful feet. He had gained weight and felt well. Roentgenograms revealed diminution of the degree of osteoporosis. The concentration of calcium was 9.4 mg. per 100 cc. of serum.

Case VIII. A Jewish man, aged twenty-one years, registered at the clinic in May, 1940, complaining of having had two attacks of severe pain in both flanks extending to the groins, two months and one month before registration. He stated that he had suffered from enuresis until the age of thirteen years and from then on had suffered from nocturia, rising once or twice every night. Two years prior to his coming to the clinic he had difficulty passing a life insurance examination because of low urinary specific gravity. He tired easily, had a poor appetite and was chronically constipated. There was no history of loss of weight.

The results of physical examination were not remarkable except for a small, soft mass low on the right side of the neck in the vicinity of the right lobe of the thyroid gland.

The concentration of hemoglobin was 12.7 mg. per 100 cc. of blood and erythrocytes numbered 4,270,000 per cubic millimeter of blood. The urine had a specific gravity of 1.011 to 1.012 and pyruria was graded 2 (on a basis of 1 to 4) with twenty-five cells per high-power microscopic field. The concentration of urea was 32 mg. per 100 cc. of blood. The urea clearance was 18.4 cc. per minute with a volume of 100 cc. The concentrations of calcium and of phosphorus averaged 17.1 mg. and 2.0 mg. per 100 cc. of serum, respectively, and plasma phosphatase averaged 6.8 Bodansky units. The Sulkowitch test showed excretion of calcium grade 3 in the urine.

Roentgenographic examination of the thorax and skull did not reveal any significant pathologic findings but roentgenologic examinations of the urinary tract revealed marked mottled areas of calcification over both renal regions. Excretory urograms were interpreted as indicating slight reduction of function in both kidneys and the renal calcification was shown to be in the calices and also scattered throughout the parenchyma of both kidneys.

The parathyroid region was explored and a tumor of the right inferior parathyroid gland was removed. The serum calcium dropped rapidly following operation. On the fourth postoperative day the patient experienced tinglings in the extremities and Chvostek's sign was positive. The concentrations of calcium and phosphorus were 9.6 and 1.5 mg. per 100 cc. of serum, respectively, and the value for serum alkaline phosphatase was 4.6 Bodansky units. Seven weeks after operation the Sulkowitch reaction was graded as 0.

One year after operation the patient was examined at the clinic. He felt well. The values for calcium, phosphorus and phosphatase were 10.1 and 3.1 mg. per 100 cc. of serum and 1.6 Bodansky units, respectively. The urine showed a specific gravity of 1.018, pyuria was graded 2 (twenty-two cells per high-power field) and there was less calcification of the left renal region as compared with the roentgenograms taken before operation. However, there was then present some recognizable osteoporosis in the roentgenograms of the ribs, spinal column and pelvis.

Case IX. A married woman, aged twenty-nine years, registered at the clinic in July, 1940. She had given birth to three children, one of whom was born dead. Following the birth of her last child, twenty-one months previously, she had begun to lose weight and suffer from malaise. For six months she had noticed progressive weakness, fatigability and loss of appetite and for three weeks prior to registration she had suffered from morning vomiting. She had lost twenty-six pounds (11.8 kg.). She was hospitalized and investigated.

The urinary specific gravity was 1.010. The concentration of hemoglobin was 12.5 Gm. per 100 cc. of blood and the erythrocytes numbered 4,350,000 per cubic millimeter of blood. The blood sedimentation rate averaged 62 mm. per hour on two recordings. There was no fever but there was persistent tachycardia. Roentgenologic studies of the chest and stomach gave negative results. The patient was quite content on a low caloric diet and when the caloric intake was increased to 2,000 calories she complained of a feeling of overdistention. Anorexia nervosa was suspected. A differential leukocyte count, examination of blood smears, repeated blood cultures and a tuberculin test all gave negative or normal results. Nine days after admission the patient complained of abdominal pain but on examination the abdomen was soft and no masses were palpable. She became restless, the pulse rate rose further and on the evening of the ninth hospital day she suddenly became cyanosed and died.

Necropsy revealed a tumor of the right inferior parathyroid gland, measuring 4 by 2 by 2 cm. and weighing 4.2 Gm. There was an extreme degree of decalcification of the skull, vertebrae and ribs. The calvarium was so soft that it could be indented by finger pressure. The kidneys showed deposition of calcium in the walls of the collecting tubules and hyalinization of numerous glomeruli. On gross examination the calcium appeared to be deposited at the corticomedullary junction. Calcium was also found in the walls of the alveoli and bronchi. The bones showed proliferation of young connective tissue in the narrow spaces with many osteoclasts next to the lacunae. The terminal event was severe hemorrhagic edema of the lungs with beginning pneumonia.

Case X. An unmarried woman, aged thirty-six years, came to the clinic in August, 1940, complaining of pains in the knees of three years' duration. Just prior to admission, the ankles had also become painful. She had felt weak and had been easily exhausted for three years. For two years she had experienced an unexplained fever with temperature up to 102°F.

Physical examination revealed moderate dorsal kyphosis and a pressure tenderness over both patellae. The urinary specific gravity ranged from 1.007 to 1.010. The concentration of hemoglobin was 13.3 Gm. per 100 cc. of blood and erythrocytes numbered 4,670,000 per cubic millimeter of blood. The concentration of urea was 18 mg. per 100 cc. of blood. The concentrations of calcium and phosphorus were 14.8 and 1.6 mg. per 100 cc. of serum, respectively, and for phosphatase 4.9 Bodansky units. The urinary excretion of calcium as indicated by the Sulkowitch test was graded 2 on a basis of 1 to 4.

Roentgenograms revealed generalized osteoporosis with areas of rarefaction in the patellae. There was no evidence of renal calcification.

The parathyroid regions were explored and a tumor of the upper left parathyroid gland was removed. On the third day after operation the patient experienced numbness and tinglings of the fingers and toes. The concentration of calcium was then 9.1 mg. per 100 cc. of serum. Recovery was very satisfactory. She was dismissed three weeks after operation. Occasional paresthesias which she was having at that time could be controlled with the administration of calcium lactate by mouth.

Case XI. This case is reported through the courtesy of Dr. Frank Heck. An unmarried woman, aged twenty-one years, registered at the clinic in June, 1941. She had been in good health until 1936 when she began to notice stiffness of the interphalangeal joints with aching on movement. In 1938, a tooth had been extracted. Following this she had been in bed for three months with weakness, nausea and vomiting

and pain in the right side of the face and head. She lost seventy pounds (31.8 kg.). Examinations of blood had revealed some anemia and leukocytosis. She did not recover completely from this upset. Walking became difficult and weakness and dyspnea developed on exertion. For several months before admission to the clinic she suffered from a dull ache in the left costovertebral angle with some extension to the left groin.

Physical examination revealed pallor and some enlargement of the proximal interphalangeal joints with limitation of movement. There was a moderate degree of pes planus. A small nodule could be felt near the left lower thyroid pole. Urinalysis revealed a specific gravity ranging from 1.009 to 1.014 with albuminuria graded 2 and pyuria graded 1 (eight cells to the high-powered field). Four estimations of the concentration of urea revealed values ranging from 58 to 82 mg. per 100 cc. of blood. The concentrations of calcium and of phosphorus were 16.0 mg. and 2.9 mg. per 100 cc. of blood, respectively, and that for phosphatase was 19.1 Bodansky units. The Sulkowitch test of urinary excretion of calcium revealed a slight trace of calcium in the urine.

The concentration of hemoglobin was 10.5 Gm. per 100 cc. of blood. Erythrocytes numbered 4,770,000 and leukocytes 7,900 per cubic millimeter of blood.

Roentgenograms revealed diffuse granular osteoporosis with cystic changes in the iliac bones. There were irregular regions of calcification, many of which were partially ossified, in the soft tissues anterior to the proximal interphalangeal joints of the fingers. Roentgenograms of the renal regions revealed multiple areas of calcification in each kidney. Roentgenograms of the sinuses revealed a large cyst in the floor of the right antrum, with transformation of the bone pattern throughout the entire maxilla and mandible.

The parathyroid regions were explored and a tumor of the left inferior parathyroid was found and removed. In spite of a liberal fluid intake the concentration of urea rose to 154 mg. per 100 cc. of blood on the fifth postoperative day. After this the value for the blood urea gradually subsided and within three weeks it had reached normal levels. On the third postoperative day Trousseau's sign became positive and tingling developed in the hands and feet. This was controlled by the oral administration of calcium lactate. On the fourth postoperative day the concentrations of calcium and phosphorus were 7.4 and 2.8 mg. per 100 cc. of serum, respectively, and the value for serum alkaline phosphatase was 25.1 Bodansky units. The patient continued to have mild tingling sensations until the time of dismissal five weeks after operation. At this time she felt very well, was putting on weight and was taking 4 Gm. of calcium lactate daily. The concentrations of calcium and phosphorus were 7.8 and 2.9 mg. per 100 cc. of serum, respectively, and the value for serum alkaline phosphatase was 9.4 Bodansky units.

Case XII. An unmarried woman, aged twenty-five years, first presented herself at the clinic in January, 1940. She complained that for six months she had been subject to intermittent muscular aches and had become weak, nervous and irritable. Following physical and laboratory examinations diagnoses of nervous exhaustion and dental sepsis were made.

She returned two years later because of two attacks of left renal colic. She also complained of soreness of the right costal margin referred to the back and right shoulder. This was associated with gaseous abdominal distention on account of which she had excluded milk, cream, butter and cheese from her diet.

Physical examination revealed a pale, undernourished young woman sixty-five inches in height (165.1 cm.) and weighing ninety-two pounds (41.7 kg.). Roentgenologic examination of the urinary tract revealed multiple calculi in both kidneys. Roentgenologic cholecystography revealed a functioning gallbladder with stones. The concentrations of calcium and phosphorus were 10.7 and 1.8 mg. per 100 cc. of serum, respectively. The value for serum alkaline phosphatase was 4.1 Bodansky units.

In February, 1942, right pelviolithotomy was performed, followed in June, 1942, by left pelviolithotomy. At this time the possibility of hyperparathyroidism was again considered. Repeated estimations of the concentration of calcium revealed values ranging between 12.2 and 13.9 mg. per 100 cc. of serum with an average of 13.3 mg. The concentration of phosphorus ranged between 1.9 and 2.3 mg. per 100 cc. of serum with an average of 2.1 mg. The value for serum alkaline phosphatase was 3.5 Bodansky units. The concentration of protein was 7.0 Gm. per 100 cc. of serum

and for hemoglobin 12.5 Gm. per 100 cc. of blood. Roentgenograms of the head and long bones revealed slight generalized osteoporosis. Roentgenoscopic examination of the thorax did not reveal any evidence of mediastinal tumor. The specific gravity of the urine ranged from 1.008 to 1.020 and the concentration of urea was 20 mg. per 100 cc. of blood. The Sulkowitch test showed calcium excretion graded 4.

A diagnosis of hyperparathyroidism was made and on June 30, 1942, the parathyroid regions were explored and a parathyroid tumor was removed.

On the third postoperative day cramping and tinglings in the extremities and a positive Chvostek sign developed. The concentrations of calcium and phosphorus were 10.0 and 1.9 mg. per 100 cc. of serum, respectively. The clinical evidences of tetany were controlled by oral administration of calcium lactate. Seventeen days after operation the concentration of calcium had fallen to 8.5 mg. and that of phosphorus had risen to 3.4 mg. per 100 cc. of serum. The value for serum alkaline phosphatase was 4.1 Bodansky units and the patient was free from symptoms.

In September, 1942, cholecystectomy and appendectomy were performed and a ganglion was excised from the ventral surface of the right wrist. Analysis of a gallstone removed with the gallbladder revealed 0.55 mg. of calcium per 100 mg., present as calcium carbonate.

The patient was dismissed from the clinic on October 14, 1942, at which time she was gaining weight and stated that she felt in excellent condition.

Case XIII. A man, aged thirty-one years, presented himself at the clinic on July 8, 1942, complaining of weakness of the legs and pains in the hips and knees. During the eight years preceding his visit to the clinic he had lost thirty-six pounds (16.3 kg.) and he had noticed a decrease in height of two and three-fourths inches (7.0 cm.). He had been treated for anemia by his local physician. Three years before registration at the clinic he had undergone partial gastrectomy for duodenal ulcer. Three months before registration tonsillectomy had been performed without improvement in his general condition.

Physical examination revealed a white man sixty-eight and one-fourth inches (173.4 cm.) in height and weighing 120 pounds (54.4 kg.). There was evidence of considerable generalized muscular weakness. On walking, the patient tended to swing the pelvis from side to side. There was no tumor palpable in the neck.

The urinary specific gravity ranged from 1.026 to 1.028. Albumin was present in one specimen of urine. Excretion of calcium in the urine was graded 2 as measured by the Sulkowitch test. The concentration of urea was 40 mg. per 100 cc. of blood.

The concentration of hemoglobin was 12.7 Gm. per 100 cc. of blood and examination of a blood smear did not reveal any diagnostic features. The concentration of protein was 6.5 Gm. per 100 cc. of serum. A flocculation test for syphilis was reported as giving negative results.

Roentgenograms revealed diffuse osteoporosis of the entire skeleton with fibrocystic changes in the ribs, ilia and right tibia. A roentgenogram of the thorax revealed slight bilateral diffuse pulmonary fibrosis and bilateral emphysema. Roentgenoscopic examination of the thorax for possible mediastinal tumor gave negative findings.

On the basis of the roentgenologic findings, estimations of the serum calcium, phosphorus and phosphatase were made. The average concentration of calcium was 13.0 mg. and for phosphorus 2.0 mg. per 100 cc. of serum. The serum alkaline phosphatase measured 17.8 Bodansky units.

A diagnosis of hyperparathyroidism was made and the parathyroid region explored on July 21, 1942. A parathyroid tumor was found and removed. On the third postoperative day tinglings and crampings in the extremities and a positive Chvostek sign developed. Estimation of the concentration of calcium and phosphorus at this time revealed values of 7.6 and 2.5 mg. per 100 cc. of serum, respectively. The tetany was relieved by oral administration of calcium lactate and vitamin D.

The patient was dismissed from the clinic on August 1, 1942, in good general condition, although Chvostek's sign was still positive. He was advised to follow a high calcium diet. At the time of his dismissal the Sulkowitch reaction for urinary excretion of calcium was graded 0, the concentrations of calcium and phosphorus were 8.5 and 2.1 mg. of serum, respectively, and the serum alkaline phosphatase recorded 42.7 Bodansky units.

Case XIV. A woman, aged fifty-five years, first registered at the clinic on July 23, 1942. She complained that for four years she had suffered from severe generalized weakness with soreness in the bones and muscles of the legs. Ligation of varicose veins and treatment for arthritis did not relieve her distress. Sixteen months before registration at the clinic she had a bony tumor removed from the left tibia at which time she was told that she had little calcium in her bones. Eight months previous to registration she underwent an operation on her neck in the course of which a parathyroid tumor was said to have been removed; however, she did not improve and became bedridden because of weakness. Two months prior to registration she had an attack of colicky pain in the right flank associated with nausea and vomiting. Four days before presenting herself she passed a stone during micturition.

Physical examination revealed a pale, edentulous woman unable to arise from bed. There was considerable dorsal kyphosis. There was a transverse scar in the neck and a small nodule was palpable in the region of the lower pole of the thyroid gland on the right side. There was a linear scar over the left tibia, the subcutaneous surface of which was irregular.

The concentration of hemoglobin was 10.8 Gm. per 100 cc. of blood. The erythrocytes numbered 3,780,000 and the leukocytes 4,200 per cubic millimeter of blood. The concentration of urea was 16 mg. per 100 cc. of blood. In repeated estimations the concentrations of calcium ranged between 12.7 and 13.7 mg., those for phosphorus between 1.9 and 2.2 mg. per 100 cc. of serum and those for phosphatase between 8.4 and 15.8 Bodansky units. The concentration of protein was 5.8 mg. per 100 cc. of serum. A flocculation test for syphilis was recorded as giving negative results. The urinary specific gravity ranged between 1.002 and 1.011. The Sulkowitch test revealed grade 2 excretion of calcium. Analysis of a stone passed in the urine revealed it to be composed of calcium phosphate.

Roentgenologic examination revealed regions of fibrocystic disease involving the bones of the leg and thigh, left scapula and both ilia. The calvarium appeared decalcified. There was a sclerosing process involving the innominate bones, entire spinal column, ribs and both clavicles. Multiple opaque shadows were present in the region of the gallbladder. Urographic studies revealed a stone in the lower calix of the left kidney. Roentgenologic examination of the thorax revealed slight cardiac enlargement with torsion of the aortic arch. There was no evidence of an intrathoracic tumor.

A diagnosis of hyperparathyroidism was made and on July 29, 1942, the parathyroid regions in the neck were explored but no parathyroid tumor was found. The thyroid gland was found to be enlarged and it contained multiple adenomas. Subtotal thyroidectomy was performed. On October 16, 1942, the anterior mediastinum was explored through a sternal splitting approach and a parathyroid tumor was removed from the left side of the anterior mediastinum.

The postoperative course was uneventful. By the fourth postoperative day the concentration of calcium had fallen to 8.5 mg. per 100 cc. of serum and on the fifth day the concentrations of calcium and phosphorus were 7.0 and 1.9 mg. per 100 cc. of serum, respectively. The serum alkaline phosphatase was 15.9 Bodansky units. No evidence of tetany appeared. Throughout the postoperative period the patient was given calcium lactate and vitamin D by mouth. She was dismissed from the clinic on November 2, 1942, at which time she stated that she felt better than she had felt for years.

REVIEW OF THE CLINICAL FEATURES OF FOURTEEN CASES OF HYPERPARATHYROIDISM DUE TO PARATHYROID TUMOR

Age. The average age at the time of operation was thirty-six years. The youngest patient was a girl aged fourteen years and the oldest a woman aged fifty-five years.

Sex. There were ten women (71.4 per cent) and four men (28.6 per cent). In their review of cases of proved hyperparathyroidism Wilder and Howell found thirty-one men and ninety-nine women and five cases in which the sex was not reported.

Duration. The average duration of symptoms was 3.9 years. The longest duration of symptoms occurred in Case v. Backache had commenced eleven years and renal colics nine years before operative removal of the parathyroid tumor. When

the patient was first seen at the clinic, seven years after the onset of backache, there were no appreciable roentgenologic changes in the spinal column and pelvis. A rotentgenogram of the skull was not made at that time. Albright, Aub and Bauer[3] reported a case in which there was reason to believe that the symptoms of hyperparathyroidism had existed for thirty-nine years.

The shortest duration was found in Case II, in which a girl, aged fourteen years, presented symptoms of sixteen months' duration.

Type of Disease. Many writers have attempted to classify cases of hyperparathyroidism into clinical groups. Cases were reported depending on whether changes in the urinary tract or changes in the skeletal system dominated the clinical picture. Acute parathyroid poisoning has also been described.

Following the classification of Albright, Aub and Bauer, eight patients (57.1 per cent) (Cases I, III, IV, VI, X, XI, XIII and XIV) might be said to have suffered from classic hyperparathyroidism with decalcification, cysts, tumors and fractures predominant in the clinical picture; however, in five of these cases symptoms or signs referable to the urinary tract were also present. Six months after operation one patient (Case I) was found to have a left renal calculus which subsequently required removal. One patient (Case III) suffered from marked polyuria and polydipsia before operation. One patient (Case X) had a persistently low urinary specific gravity before operation and another patient (Case XI) showed multiple regions of calcification in each kidney with a decreased urinary specific gravity and an elevation of the concentration of urea in the blood. Case XIV presented both cholelithiasis and nephrolithiasis.

Four patients (28.6 per cent) (Cases V, VII, VIII and XII) presented nephrolithiasis as the most prominent early feature. One patient (Case V) underwent right pelviolithotomy four years before the diagnosis of hyperparathyroidism was made. Another (Case VII) underwent right nephrectomy for a stone-filled kidney. Following this operation, symptoms resulting from hypercalcemia and skeletal disease appeared and four years later the correct complete diagnosis was made. A third patient in this group (Case VIII) presented himself with bilateral renal calculi and nephrocalcinosis but with negligible skeletal involvement. However, one year after removal of the tumor there was recognizable osteoporosis of the ribs, spinal column and pelvis. The fourth patient in this group (Case XII) was operated upon for bilateral nephrolithiasis before hyperparathyroidism was recognized. Diagnosis was delayed because the concentration of calcium before the first pelviolithotomy was 10.7 mg. per 100 cc. of serum, although that of phosphorus was depressed to 1.8 mg. per 100 cc. of serum. Subsequently, evidence of hypercalcemia and decalcification developed. This patient also suffered from cholelithiasis.

One patient (Case II) presented a clinical picture of the type described as hyperparathyroidism with renal insufficiency. However, the skeletal system was roentgenographically shown to have undergone marked decalcification, formation of cysts and pathologic fractures.

One patient (Case IX) suffered from the type of disease described as acute parathyroid poisoning.

No patient was found to fall into the group of the uncomplicated osteoporotic form of hyperparathyroidism or hyperparathyroidism simulating Paget's disease, as described by Albright, Aub and Bauer. In Case XIV, however, there was roentgenographic evidence of the sclerosing process involving the innominate bones, spinal column, ribs and clavicles.

Miscellaneous Clinical Data. The two most consistent symptoms were weakness and fatigability. These were found in every case. Other symptoms and signs, probably dependent upon hypercalcemia, were, in order of frequency of occurrence, loss of weight, impaired appetite, constipation,

indigestion, nausea and vomiting. Pes planus, possibly due to muscular hypotonia, was present in two cases.

Changes in the skeleton caused the patients to have symptoms of a more painful nature. Nine patients in this group had among their chief symptoms pain in the lower extremities or in the back and lower extremities. Loss of height and the development of kyphosis were noted in seven cases. Pathologic fracture occurred in six cases. A bone tumor in the maxilla was present on gross examination in one case. This tumor disappeared spontaneously after removal of the parathyroid tumor. Roentgenographic examination revealed a large cyst in the floor of the maxillary sinus in one case. Stiffness of the fingers with limitation of movement, superficially resembling infectious arthritis of the fingers, was noticed in one case.

Roentgenologic studies of the skeletal system were not done on one patient (Case IX), but necropsy revealed gross osteitis fibrosa generalisata. Preoperative roentgenologic studies revealed osteoporosis with regions of formation of cysts, localized rarefaction or pathologic fracture in eleven cases. Two patients showed merely generalized osteoporosis and one patient did not show any recognizable bony changes preoperatively, although osteoporosis was recognized postoperatively. Thus, all patients showed some bony abnormality.

Symptoms and signs dependent upon excretory factors were only slightly less prominent than those of the skeletal system. In four instances (28.6 per cent) the patients first sought medical attention because of renal calculi and, in all, renal calculi or calcification in the kidney was recognized in eight cases (57.1 per cent). Polyuria and polydipsia were noticed by the patient in five instances. In one instance (Case III) these were severe, the fluid intake being as much as 12 liters in twenty-four hours. However, in nine cases the specific gravity of the urine was found to be consistently low and relatively fixed. In two of these cases the concentration of urea was elevated to as high as 80 mg. per 100 cc. of blood before operation. Impaired renal function in two more of these cases was evidenced in the excretory urographic findings and in the results of urea and sulfate clearance tests.

Studies of calcium balance were carried out in the first four cases. A negative balance for calcium was found in three cases. In one instance, however, (Case I) the calcium balance was positive but this test followed treatment with ultraviolet light and vitamin D. The Sulkowitch test was applied preoperatively to the urine in six cases and the precipitate was graded as 4, on a basis of 1 to 4, in one case, 3 in one case, 2 in three cases and in another the test was interpreted as showing a trace of urinary calcium.

Roentgenologic examination of the thorax revealed in two instances (14.3 per cent) the partial outline of a tumor which was subsequently shown to be the parathyroid tumor. Spontaneous fractures of ribs were found in two cases and in one case metastatic calcification in the pulmonary parenchyma was recognized.

The parathyroid tumor was itself palpable in three cases (21.4 per cent) while in two additional cases it pushed up the corresponding lobe of the thyroid sufficiently to give rise to a palpable mass. These five cases include the two cases in which the parathyroid tumor was visualized in the roentgenogram of the chest.

Examination of the blood revealed a concentration of hemoglobin of less than 12 Gm. per 100 cc. of blood in five cases. However, most patients had received some form of anti-anemic treatment during the course of their chronic illness.

The concentrations of calcium and phosphorus in the serum were estimated in thirteen cases. In four cases (30.8 per cent) the concentration of calcium was less than 12.5 mg. per 100 cc. of serum on at least one estimation. The lowest value recorded was 10.6 mg. per 100 cc. In all thirteen cases at least one estimation of the concentration of phosphorus was less

than 3 mg. per 100 cc. of serum. The highest estimation exceeded 3 mg. in only one instance. The value for serum alkaline phosphatase was estimated in ten cases and values from 3.5 to 61.7 Bodansky units were found before operation.

Following operative removal of the parathyroid tumor the concentration of calcium in the serum fell to normal or subnormal levels within twenty-four hours and within the first four days after the operation some manifestations of tetany, subjective or objective, were recorded in all but one instance (Case XIV). The duration of these manifestations varied from a few days to several weeks.

The concentration of phosphorus in the serum rose slowly to normal limits. Often, however, this rise followed a temporary further decrease during the immediate postoperative period. The value for serum phosphatase sometimes became more elevated after operation and in one case had not returned to normal levels seven months after operation. Return to normal limits was more rapid in those cases in which there was less skeletal damage.

A marked decrease of the urinary output of phosphorus and calcium was observed to follow operation in those cases in which balance studies were carried out.

In Case IV death followed operation on the seventy-seventh postoperative day. In the remainder of the cases in which operation was performed, considerable subjective and objective improvement followed operation. Gain of weight and strength was great and some patients stated that they felt better than they had felt for years. Pain and tenderness of the bones decreased or disappeared and the bones recalcified slowly. In Case I a bone tumor of the maxilla disappeared spontaneously. Renal function improved and in Case VIII roentgenologic examination of the regions of the kidneys one year after removal of the parathyroid tumor revealed some decrease of the degree of nephrocalcinosis.

In one instance (Case IX) operation was not performed because the correct diagnosis was not made before death. Anorexia nervosa was suspected and treatment directed toward this was instituted, pending further investigation. However, abdominal pain, restlessness and tachycardia suddenly developed and in a few hours the patient became cyanosed and died.

COMMENT

When first confronting the physician, these patients appeared to present widely different diagnostic possibilities. First impressions of the physician included renal calculi, sciatic neuritis, chronic glomerulonephritis, nutritional deficiency with anemia and osteoporosis, menopausal osteoporosis, anorexia nervosa, chronic infectious arthritis, osteomyelitis and bone tumor. Further investigation, however, usually either discredited the tentative diagnosis or revealed the underlying etiologic factor. In one instance, however, the clinical picture so closely resembled anorexia nervosa that the patient died in acute hyperparathyroidism before the diagnosis was established.

The course of events immediately preceding death in this case was similar to the terminal phenomena in the cases of acute hyperparathyroidism reported by Dawson and Struthers, Hanes, Oliver, and Smith and Cooke. Albright[2] has advised that patients who have severe hyperparathyroidism be placed on a diet low in calcium until the offending tumor can be removed. He stated the danger signals of parathyroid poisoning to be rising concentrations of phosphorus and nonprotein nitrogen in the serum associated with urinary suppression.

In four instances the concentration of calcium was less than 12.5 mg. per 100 cc. of serum on at least one estimation. In Case I, however, repeated examinations revealed higher values. In Case IV, the diagnosis was deferred for two years because of the apparent absence of hypercalcemia. In Case VI, the diagnosis was made at the first examination at the clinic in spite of a concentration of calcium of

11.2 mg. per 100 cc. of serum. In Case XII the initial estimation of the concentration of calcium was 10.7 mg. per 100 cc. of serum. Bilateral removal of renal calculi was carried out before the hyperparathyroidism was recognized.

Shelling has placed the normal concentration of calcium in the serum at 9.5 to 11.5 mg. per 100 cc. with an average value of 10.5 mg. per 100 cc. In hyperparathyroidism, he found the values to range from 12.5 to 29.4 mg. per 100 cc. However, in 1937, Albright, Sulkowitch and Bloomberg,[4] reporting on thirty-five cases of hyperparathyroidism from the Massachusetts General Hospital, found eleven cases in which the concentration of calcium was less than 12.5 mg. per 100 cc. of serum.

The Sulkowitch test showed calcium excretion preoperatively graded more than 2 in two (33.3 per cent) of the six cases in which the test was applied. The test provides a rough index of the presence or absence of excessive urinary calcium at the time of its application and can be regarded only as a rough bedside test, by no means diagnostic of hyperparathyroidism. In conditions of acidosis the urinary excretion of calcium is increased and the Sulkowitch reaction may be strongly positive. In both instances in which the Sulkowitch reaction was strongly positive in this series the most prominent clinical manifestation was renal lithiasis. In one instance the concentration of calcium before operation averaged 13.3 mg. and in the other instance 17.1 mg. per 100 cc. of serum. On the other hand, in four cases (66.7 per cent) of proved hyperparathyroidism, in two of which renal calculi were present, the Sulkowitch test did not reveal an excess of urinary calcium. The test is thus only of supplementary value and must be considered along with the whole clinical picture. The dietary supply of calcium and any tendency toward acidosis must also be considered in reaching the correct interpretation of the Sulkowitch test.

In only one instance was the concentration of phosphorus higher than 3.0 mg. per 100 cc. of serum. In this case (Case II) there were impairment of renal function as evidenced by polyuria, a urine of low fixed specific gravity, elevation of the concentration of urea in the blood and impaired excretion of phenolsulfonphthalein. Albright, Aub and Bauer have shown that the value for serum phosphorus may not be low in cases in which hyperparathyroidism has progressed to marked renal insufficiency.

Albright, Aub and Bauer expressed the belief that the serum phosphatase level is an index of osteoblastic activity and found it to be elevated in hyperparathyroidism in proportion to the amount of disease of bone present. This finding is borne out in the series of cases under study. In Cases VIII, X and XII, with average preoperative values for serum phosphatase of 6.8, 4.9 and 3.8 Bodansky units, respectively, there was either no recognizable bony disease (Case VIII) or slight bony rarefaction (Cases X and XII). In the other cases the changes in the bone were greater and the serum alkaline phosphatase values were more than 10 Bodansky units.

In 1937, Albright, Sulkowitch and Bloomberg[4] found that in twelve of thirty-five cases there was no demonstrable disease of bone. These cases had been recognized by the routine investigation of cases of nephrolithiasis for other possible evidence of hyperparathyroidism.

In the series under present discussion, three patients (21.4 per cent) had operative procedures for renal calculi without bone changes being recognized. On one patient (Case V) right pelviolithotomy was performed at the clinic. Four years later, bony changes had developed and the complete diagnosis was made. From another patient (Case VII) the right kidney had been removed elsewhere before the diagnosis of hyperparathyroidism was made at the clinic. At the time of the first operation the patient had not made any complaints other than of right renal colics but severe changes of bone were present when he was seen at the clinic four years

later. From another patient (Case XII) calculi were removed at the clinic from both kidneys before roentgenologic evidence of slight bony decalcification was recognized. In Case VIII bilateral renal calculi were present and roentgenograms taken before removal of the parathyroid tumor did not reveal any bony changes. However, following operation, osteoporosis was recognized. In this case the duration of symptoms was two years, while the average duration of symptoms for the whole group was 3.9 years. These observations lend support to the contention that changes of bone are an index of the duration of the disease rather than of its severity. They also emphasize the importance of keeping hyperparathyroidism in mind when dealing with cases of renal lithiasis.

Eight patients (57.1 per cent) showed evidence of renal lithiasis or nephrocalcinosis. In 1934, Albright, Baird, Cope and Bloomberg[5] reported the incidence of renal calculus in hyperparathyroidism to be 27 per cent. However, in 1937, Albright[1] stated that hyperparathyroidism carried an incidence of renal calculus of about 70 per cent. There has been much debate regarding the incidence of hyperparathyroidism in cases of renal calculus. Barney and Mintz,[10] in 1934, stated that parathyroid disease is the apparent etiologic factor in at least 10 per cent of the cases in which stones form in the urinary tract. Later, in 1936,[11] from 4 to 5 per cent was given by the same authors as a more correct figure. In 1937, Albright[1] considered that about 5 per cent of renal calculi consisting of calcium phosphate were due to hyperparathyroidism. In 1938, Griffin, Osterberg and Braasch found hyperparathyroidism to be an etiologic factor in less than 0.2 per cent of 1,206 cases of urinary lithiasis which they studied at the Mayo Clinic; however, in only 229 of these cases were laboratory studies of the serum calcium, phosphorus and alkaline phosphatase performed.

Study of the fourteen cases under review supports the statement of Albright that in all cases of renal stones consisting of calcium phosphate hyperparathyroidism should be suspected until this is ruled out by chemical studies, regardless of whether or not disease of bone is present.

Section II. Pathologic Considerations

The General Features of Parathyroid Tumors

The first descriptions of parathyroid tumors were probably given by DeSanti in 1900 and Benjamins in 1902.

DeSanti found a large vascular tumor in the thyroid region of a man aged fifty-eight years. This was removed at operation undertaken because of hoarseness, dyspnea and cough. Microscopic examination showed that the tumor consisted of parathyroid tissue.

Benjamins' case was that of a man fifty-seven years of age who had a tumor in the neck the size of a child's head. This was removed surgically. It was round and circumscribed and did not show any invasive tendencies. It was removed because of the mechanical disturbance that it caused. From its situation and structure Benjamins considered it to be a parathyroid tumor.

In 1915, Harbitz reviewed the literature on the parathyroid tumors described up to that time. He found that most of them had been accidentally discovered at necropsy. The majority were small, single tumors averaging from 2 to 2.5 cm. in diameter and were soft and grayish red. In a few cases the tumors were larger and had been removed at operation because of pressure on the surrounding structures. In these cases, which included DeSanti's and Benjamins', the tumors were so meagerly described as regards structure that Harbitz was not entirely convinced of their parathyroid origin.

In 1925, Hoffheinz commented on all the cases of parathyroid enlargement which he could find reported from 1900 to 1925. He found forty-five cases in which

parathyroid tumor or hyperplasia was certain. In 1930, Barr and Bulger were able to add another twenty-nine cases, bringing the total to seventy-four cases. However, only about seventeen of these were considered by Barr and Bulger[12] to be cases of parathyroid tumor.

Since Mandl's[50] contribution to the surgical treatment of parathyroid tumors many more cases have been reported and more careful histologic studies have been performed. In 1931, Hunter and Turnbull gave a careful description of the clinical and pathologic features of cases of generalized osteitis fibrosa due to parathyroid hyperfunction. They found that any of the cellular elements normally present in the parathyroid might be involved, separately or in combination, in the hyperplastic or neoplastic process, causing hyperparathyroidism with generalized osteitis fibrosa. Erdheim[27] found the oxyphil cells to predominate in the enlarged parathyroids associated with skeletal disease, while Hoffheinz and Wellbrock found the clear, chief cells to be more in abundance.

In 1935, Castleman and Mallory reported the detailed histologic appearance of the parathyroid glands in twenty-five cases of hyperparathyroidism. They found it possible to divide the cases sharply into two groups. The first group was characterized by diffuse uniform changes throughout all the glandular tissue, an obviously hyperplastic process. The second group was characterized by a proliferative region limited to one gland, frequently even to a portion of it, or, rarely, involving parts of two glands. They regarded this localized type of growth as neoplastic.

They proposed further subdivision of each group based on the morphologic criteria of the predominant cell type and the cellular arrangement. They were able to apply this classification to a group of 160 cases of hyperparathyroidism, of which they collected reports from the literature.

They found the incidence of hyperplasia to be 13.6 per cent and of neoplasia to be 86.4 per cent. The hyperplasia most commonly was of the generalized wasserhelle cell type. The neoplasia was single in 128 of 140 cases and multiple in twelve. The chief cell with its transition forms was by far the most common cell type in the neoplastic group, although wasserhelle cell types were also seen.

Castleman and Mallory were able to show a rough quantitative relation between the size of the enlarged glands and the degree of hyperfunction as judged by the degree of elevation of the concentration of calcium in the serum.

In 1940, Fahrni reported that in his series of seven patients who had hyperparathyroidism, two patients each had two tumors. Of the nine parathyroid adenomas, three were in the mediastinum, one was intrathyroid and five were in the normal position of one of the parathyroid bodies.

In 1941, Cope reported on sixty cases of hyperparathyroidism observed at the Massachusetts General Hospital. The diagnosis was proved at operation in fifty-eight cases and at necropsy in two cases. In fifty-four cases the disease was due to formation of adenoma and in six, to primary hyperplasia. In four of the fifty-four cases due to adenoma there were two adenomas, in the rest only one. Of this total of fifty-eight adenomas, eleven were found in the anterior mediastinum and five in the posterior mediastinum.

MALIGNANT PARATHYROID TUMORS

In 1899, Kocher reported five malignant glycogen-containing tumors which he had observed in the region of the thyroid gland. He expressed the belief that these were of parathyroid origin. In 1907, Langhans described four similar cases in which he interpreted the lesions as malignant parathyroid tumors. In 1915, Harbitz was inclined to interpret these as cases of primary malignant tumors of the thyroid gland rather than of the parathyroid glands. In 1909, de Quervain described an invasive, infiltrating tumor of the neck which he believed had the

histologic appearance of a parathyroid tumor. Following operation, the tumor recurred locally and metastasized to the lungs.

In 1914, Roffo and Landivar reported the case of a patient who had noticed a lump in the neck for thirty-five years. This had grown considerably and was associated with a mediastinal tumor simulating an aortic aneurysm. These tumors were removed but the patient died four months after operation. Necropsy revealed local recurrence, invasion of the thyroid gland and metastatic growths in the lungs and liver. Histologically, the tissue of the tumors was found to be composed of follicles with columns of cylindrical cells containing nuclei in mitosis. Roffo and Landivar expressed the belief that these tumors were of parathyroid origin.

In 1923, Fasiani reported a tumor of the neck which had invaded the thyroid gland. The tumor cells showed much mitosis and were believed to have arisen from a parathyroid gland. He expressed the belief that the tumor was a malignant parathyroid adenoma.

In 1925, Ferrero and Sacerdote reported the case of a woman in whose femur a tumor developed. She had noticed a small tumor in the neck for fourteen years. In the course of the examination the femur fractured but union occurred within the usual period. They expressed the belief that the tumor of the femur had the structure of the parathyroid gland. A month following the fracture a growth, presumed to be metastatic, appeared in the right temporal bone. There were no other osseous changes reported.

In 1926, Hendrioch reported a case of a retrosternal tumor which was removed from a woman aged seventy-one years. This tumor was largely surrounded by the thyroid tissue of the lower pole of the thyroid gland. There was also a smaller tumor in the thyroid tissue of the upper pole. Histologically, the tumor cells resembled parathyroid tissue and a palisade arrangement was frequently noted. In the larger mass, oxyphil cells were absent, the tumor was invading the thyroid gland, there was a departure from the physiologic structure and giant cells were present. No mitotic figures were seen. However, Hendrioch concluded that he was dealing with a malignant tumor arising from the inferior parathyroid of that side and invading the thyroid parenchyma. The smaller tumor he believed to have arisen from an upper parathyroid as an adenomatous enlargement rather than as a metastasis from the larger tumor.

In 1927, Alessandri reported a case of combined thyroid and parathyroid tumor of the right humerus in a man aged fifty-one years. The tumor recurred following resection and interscapulothoracic disarticulation was performed. Although no tumor was found in the neck, the tumor tissue from the arm showed evidence of parathyroid adenocarcinoma as well as thyroid carcinoma and normal thyroid tissue. There was no record of changes in other bones. There was no evidence of recurrence one year after the interscapulothoracic disarticulation.

In 1929, Guy reported the case of a woman aged twenty-nine years. A tumor in the thyroid region had been present for five years and was removed with little difficulty. It measured 8 by 6 by 4 cm. and consisted of closely packed clear cells arranged irregularly and in palisades. The nuclei were large and dark, round or oval and rich in chromatin. Mitotic figures were occasionally seen. A diagnosis of parathyroid adenoma was made. However, within one year of operation three nodules developed in the neck. Biopsy and later excision of these nodules were performed and the tissue removed gave evidence of an actively growing malignant epithelial tumor. Two years and four months after the first operation the masses were much larger and ulcerating and pulmonary metastatic growths were present.

In 1931, Toland described a case in which operation was followed by death with pulmonary metastasis within four

months. A woman, aged sixty years, had noticed a swelling in the neck for eight years. At operation the mass was found to be densely adherent to the muscles. It was removed, along with the entire right lobe of the thyroid gland. Microscopic examination revealed irregular atypical cells of various sizes and shapes. The nuclei were large and hyperchromatic and contained a deeply staining nucleolus. The cellular arrangement was irregular. The tumor was considered to be a parathyroid adenocarcinoma.

In 1932, Price and Mowatt described the case of a man, aged forty-nine years, who presented a tumor the size and shape of a hen's egg, behind the angle of the jaw on the left side. Because of the infiltrative invasion of the surrounding tissues, including the internal carotid artery, only portions of the neoplasm could be removed and radium therapy was resorted to. Microscopic examination of the tissue removed revealed one region in which the cells showed palisade formation and a scattered alveolar arrangement with central colloid. The cytoplasm was abundant and finely granular. The nuclei were large, oval and rich in chromatin and contained a deeply staining nucleolus. In the greater part of the tumor the cells showed much vacuolization of the cytoplasm and the alveolar structure was not seen.

Price and Mowatt expressed the belief that this was a malignant parathyroid tumor arising in a parathyroid rest. There was no evidence of hyperparathyroidism. The patient died with metastatic growths about nine months after operation.

In 1934, Hall and Chaffin[36] described the case of a white man, aged forty-six years, who presented himself because of a lump in the neck. The basal metabolic rate was elevated, ranging between +31 and +47 per cent. A cystic tumor of the thyroid gland was removed and this contained a nodule of hyperplastic thyroid tissue in its wall. Behind this tumor was a large mass of liver-like tissue which was also removed. This mass weighed 120 Gm. and measured 11 by 8 by 5 cm. Microscopic examination revealed the mass to be made up of columns and groups of small cells with faintly granular cytoplasm and relatively dark-stained vesicular nuclei. Scattered groups of large, clear cells and a few oxyphil cells were seen. A diagnosis of parathyroid adenoma was made. There was no evidence of hyperparathyroidism.

Sixteen months after operation, three nodules appeared low on the left side of the neck. These were excised. There was gross and microscopic evidence of invasion of muscle. The tumors were made up of atypical epithelial cells arranged in cords and columns in some cases and irregularly in others. Some cells were polygonal with finely granular, moderately eosinophilic cytoplasm. Clear cells and fusiform oxyphil cells were also seen. The nuclei were vesicular and moderately deep-staining and contained one or more prominent nucleoli. Occasional mitosis was seen. There was apparent invasion of the blood vessels and lymphatic vessels by tumor cells. A diagnosis of parathyroid carcinoma was made.

In 1940, Hall and Chaffin[37] reported that this patient had died seven years after the first operation. Necropsy had revealed metastatic growths in the lung and tracheobronchial lymph nodes. The microscopic appearance of the metastatic growths was similar to that of the surgically removed parathyroid tumors.

In 1938, Armstrong reported the case of a woman, aged seventy-one years, who complained of a painless swelling in the right side of the neck. This was found to be stony hard and to extend into the thorax. Operative removal was difficult because of attachment to the internal jugular vein and the sternocleidomastoid muscle. The tumor measured 11 by 11 by 4 cm. The tumor cells showed a varying arrangement with columns, palisading and acinar formation. In some regions the cells were large, closely packed and acidophilic.

The nuclei were well stained. The pathologist reported the appearance to be that of a malignant parathyroid tumor. There was no evidence of hyperparathyroidism.

FUNCTIONING MALIGNANT TUMORS OF THE PARATHYROID GLANDS

Cases of malignant parathyroid tumor causing hyperparathyroidism have been reported much less frequently than cases of malignant parathyroid tumor not causing hyperparathyroidism, only seven such cases having been described in the literature.

The first reports of such a case were made by Wilder and by Wellbrock in 1929. The case which they described has been reviewed as Case I in the present study.

In 1931, Quick and Hunsberger reported the case of a white man, aged twenty-five years, who presented the clinical picture of severe hyperparathyroidism with generalized osteitis fibrosa cystica. An encapsulated parathyroid tumor the size of an olive was found at operation but this was incompletely removed on account of hemorrhage. Microscopic examination showed anastomosing cords of epithelial cells arranged in palisade fashion. The cells showed evidence of active proliferation and a diagnosis of parathyroid hyperplasia was made.

Only slight improvement followed operation so that a second attempt at operative removal of the tumor was made five months later. Microscopic examination of the tissue which was removed at the second operation revealed a picture similar to that seen in the tissue removed at the first operation, but the cells were reported to be irregular in size and to show even greater hyperactivity, suggesting the possibility of malignancy.

In 1933, Sainton and Millot reported a case in which there was evidence of malignant change in an eosinophilic adenoma of the parathyroid. The patient was a woman (age not stated) suffering from generalized osteitis fibrosa cystica which had begun in infancy. There was hypercalcemia. An eosinophilic parathyroid adenoma was removed but her general condition did not improve, secondary calcification increased and a tumor on the maxilla increased in size.

The parathyroid region was re-explored two years later and a small indurated nodule was found in the region from which the adenoma had been removed. This nodule was found to be made up of several small nodules separated by connective tissue. One of these nodules had the histologic appearance of an eosinophilic parathyroid adenoma. The cells were grouped in lobules and some showed a palisade arrangement. The cytoplasm was abundant and filled with fine eosinophilic granules. The nucleus was central, rounded and deeply staining. The structure of the other nodules, however, was much less homogeneous. The cells were irregular in arrangement and varied in staining power. Many cells had deeply staining cytoplasm and a deeply staining nucleus. Mitosis was frequently seen and many large nuclei were evident. In some regions invasion of the surrounding fatty tissue had occurred. Sainton and Millot considered these findings to be clear evidence of malignant change in an eosinophilic parathyroid adenoma.

In 1936, Snell[68] and Mayo[52] reported a case from the Mayo Clinic (Case VII in this series). Severe hyperparathyroidism was relieved by the removal of a large, grade I adenocarcinoma of the parathyroid.

In 1937, Petersma reported a case of hyperfunctioning parathyroid tumor in which he believed the tumor to be malignant. The patient was suffering from an advanced stage of the generalized type of osteitis fibrosa cystica. A small tumor was removed from the region of the lower pole of the right lobe of the thyroid gland. This tumor was composed of clearly outlined cells with water clear cytoplasm and smaller cells with more darkly staining cytoplasm. Tumor cells were found within the blood vessels and the tumor was considered malignant. One year after operation the patient was greatly improved and

there was no evidence of recurrence or of metastasis.

In 1939 Meyer, Rosi and Ragins reported the case of a white Greek man, aged fifty-six years, who complained of a painful swelling of the proximal portion of the right little finger and also of having lost forty pounds (18.1 kg.). Physical, laboratory and roentgenologic examinations revealed definite signs of hyperparathyroidism: namely, a firm tumor, about the size of a walnut, to the right of the trachea and just above the sternoclavicular joint, disseminated fibrocystic disease of the bones, renal calculi, a high value for serum calcium, a low value for serum phosphorus and a high value for serum phosphatase. Biopsy of the swelling of the proximal phalanx of the right fifth finger showed the microscopic picture of a benign giant-cell tumor of bone.

A parathyroid tumor was removed from the right side of the neck. It measured 6 by 5 by 4.5 cm. and was moderately encapsulated. Microscopic examination revealed the central portion to be composed of water clear cells and transitional cells separated by a clear stroma. Toward the periphery of the tumor mass the water clear cells were absent and the transitional cells were larger and differed in shape so that they resembled squamous epithelial cells. The nuclei were deeply stained and irregular in size and shape. In focal regions, mitotic figures were seen. Some of these were irregular and showed sharp, plump chromosomes. There was also evidence of invasion of blood and lymphatic vessels. A pathologic diagnosis of a nonhornifying squamous carcinoma of the parathyroid gland was made.

Following operation there was marked subjective improvement; the bones showed evidence of recalcification and the concentration of calcium in the serum fell to within normal limits. However, re-examination fourteen months after operation revealed a hard nodule about 3 cm. in diameter in the region of the right lobe of the thyroid gland. The long bones were again showing evidence of decalcification and laboratory studies revealed a high value for serum calcium, a low value for serum phosphorus and a slightly increased value for serum alkaline phosphatase. Meyer, Rosi and Ragins expressed the belief that they were dealing with a carcinoma of the parathyroid gland which was producing definite signs of hyperparathyroidism.

In 1941, Gentile, Skinner and Ashburn reported the first case of a functioning malignant parathyroid tumor in which definite evidence of metastasis was found. A white man, aged thirty-eight years, suffering from osteitis fibrosa cystica and typical hyperparathyroidism, had a hard nodular tumor on the left side of the neck. This measured 5 by 3 by 2 cm. and was densely adherent to the left lobe of the thyroid gland. The tumor was removed and the cells were found to be polygonal and medium to large. The cytoplasm was oxyphilic to amphophilic and the cell borders were distinct. The nuclei were medium to large, vesicular, hyperchromatic and usually centrally located and commonly contained one or more large nucleoli. (Fig. 1.) Few mitoses were seen. There was evidence of invasion of blood vessels by tumor cells.

The improvement which followed operation was only temporary. Hyperparathyroidism recurred and eight months after the first operation an enlargement of a cervical lymph node on the left side was noticed. This was removed and found to be a metastatic growth from the previously removed malignant parathyroid adenoma. Another lymph node which was removed showed a vascular space filled with tumor cells. (Fig. 2.) The patient was in excellent general condition four years after the second operation.

CASE REPORTS—PATHOLOGIC

The parathyroid tumors encountered at the Mayo Clinic have been studied grossly and microscopically. The clinical aspects of patients from whom the tumors were removed by surgical operation or at

necropsy have been described in section 1. The case numbers used in that section correspond to the case numbers used in considering the pathologic features. The tumors had been fixed in formalin. Blocks cut from different portions of the tumor were embedded in paraffin. Sections for microscopic examination were cut and stained with hematoxylin and eosin. Other sections were treated with potassium ferrocyanide and hydrochloric acid to demonstrate the possible presence of iron-containing pigment.

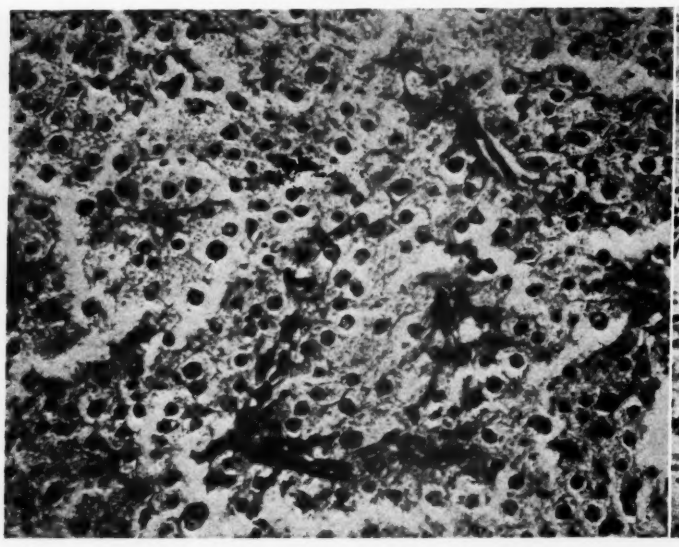

Fig. 1. Parathyroid tumor from the case of hyperparathyroidism reported by Gentile, Skinner and Ashburn. The cellular arrangement is irregular. The cytoplasm is eosinophilic and granular. The nuclei vary in size and shape and many are hyperchromatic. × 500. (Reproduced by courtesy of C. V. Mosby Company Saint Louis, Missouri.)

Fig. 2. Section from metastasis to left cervical lymph node showing intravascular tumor mass. Same case as Figure 1. × 515. (Reproduced by courtesy of C. V. Mosby Company, Saint Louis, Missouri.)

Case 1. Careful description of the pathologic features of this case was presented by Wellbrock in 1929. The tumor was situated substernally in the inferior pole of the right lobe of the thyroid gland. It measured 5 by 3.5 by 3 cm. and, including a portion of thyroid tissue attached, weighed approximately 40 Gm. The tumor was nodular and bluish gray, varied in consistency in different parts and was surrounded by a thick, fibrous capsule. The cut surface of the tumor revealed four distinct lobulated masses with irregular cystic regions.

Microscopic examination of the tumor disclosed a tendency of the cellular elements to group themselves into an alveolar arrangement. There were many vascular spaces. The cells of the tumor were large, clear and polygonal with poorly staining cytoplasm. They were of the chief and transitional wasserhelle cell types. The nuclei varied in size and stained more deeply than the nuclei of the normal parathyroid gland. Occasional mitotic figures were present. Throughout the tumor were many vesicle-like spaces around which the cells were arranged in palisade formation. The spaces contained thin, faintly staining colloid-like material. Some of the vesicle-like spaces were lined by cells of cuboidal or columnar type. In several regions the neoplastic cells appeared to be invading the capsule. No foam cells or fat cells were seen in the tumor.

Wellbrock considered the tumor to be a malignant adenoma because of the polymorphism of the cells, the hyperchromatic nuclei, the presence of mitotic figures, the apparent invasion of the neoplastic tissue into the capsule and the absence of foam cells and fat. Castleman and Mallory in reviewing this case, considered the tumor to be an adenoma of their glandular and cystic type. We are in agreement with Wellbrock and have classified this tumor as a parathyroid adenocarcinoma grade 1 (Broders' method).

Case 11. Exploration of the neck revealed a tumor lying behind the left lobe of the thyroid

gland near the inferior pole. The tumor lay outside the thyroid capsule but was attached to it. It was brownish, measured 1.5 by 1.25 by 1.25 cm. and weighed 1 Gm.

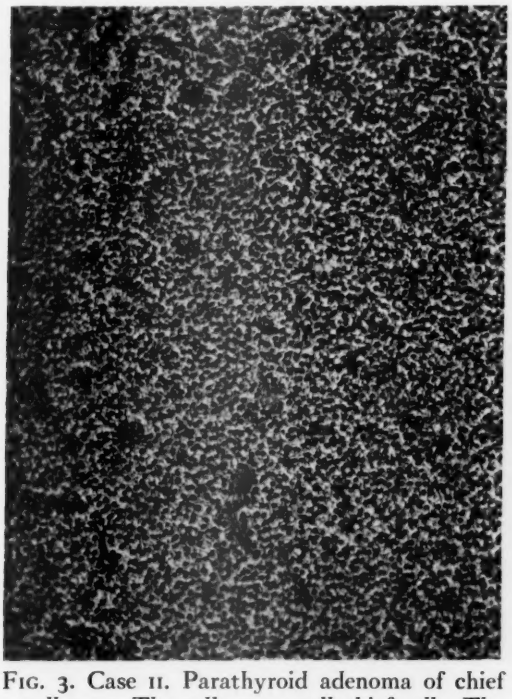

Fig. 3. Case II. Parathyroid adenoma of chief cell type. The cells are small chief cells. The nuclei are small and regular in size and shape. No giant nuclei nor mitotic figures are seen. Neither foam cells nor fat cells are present. There are some regions of pink-staining, colloid-like material (hematoxylin and eosin × 180).

Microscopic examination revealed a very cellular tumor. (Fig. 3.) The cells, which were arranged in masses separated by sinusoids and trabeculae of connective tissue, were small and of chief cell type. The nuclei were small, hyperchromatic and regular in size and shape. There were regions of pink staining colloid with peripheral vacuolization and some regions revealed a palisade effect. Neither giant nuclei nor mitotic figures were seen. There was a marked absence of the normal parathyroid fat. Sections stained with potassium ferrocyanide and hydrochloric acid revealed an iron-containing pigment along the trabeculae of connective tissue. This pigment was both intracellular and extracellular. Because of the small, regular, evenly staining nuclei and the absence of mitotic figures and giant forms, this tumor was considered to be an adenoma of chief cell type.

Case III. The tumor was situated on the posterior surface of the right lobe of the thyroid midway between the superior and inferior poles and above the point of entrance of the inferior thyroid artery into the gland. It was not embedded in the thyroid gland but was connected

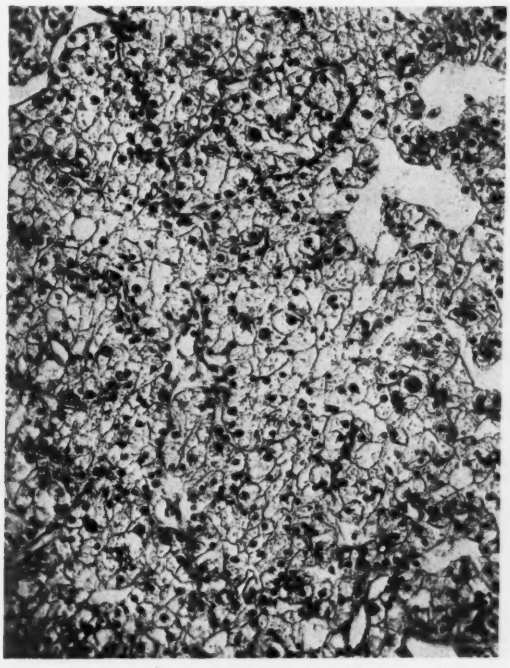

Fig. 4. Case IV. Parathyroid adenocarcinoma grade 1 of clear cell type. The cells are large, clear or wasserhelle cells arranged in masses but with a tendency to alveolar formation. The nuclei are irregular in size and shape and are hyperchromatic. Many are placed eccentrically in the cell. Large endothelial-lined sinusoids are prominent. The resemblance to hypernephroma is marked (hematoxylin and eosin × 180).

to the fascia surrounding it. The tumor projected into the groove between the trachea and the esophagus. It was soft and darkish gray and presented a mottled appearance. On removal it measured 3 by 2.5 by 2.5 cm. and weighed 10 Gm.

Microscopic examination revealed the tumor to be composed of cells resembling chief cells but with regions of larger, clear or wasserhelle type cells. The cellular arrangement was of alveolar type. The nuclei were irregular in size and shape and were hyperchromatic. Many nuclei contained prominent nucleoli. Some giant nuclei were present. Occasional mitotic figures were seen. At some points the cells gave the appearance of invading the capsule. There were many dilated sinusoids. Regions of pink-staining colloid were present and at some points about five to thirty cells could be seen surrounding a connective tissue core, giving a pseudo-

glandular effect. Staining for iron revealed iron-containing pigment along the trabeculae of connective tissue and in relation to the dilated sinusoids. Because of the irregularity of size and shape of the nuclei, the densely staining chromatin network, the giant nuclei and occasional mitotic figures, this tumor was considered to be a low grade 1 adenocarcinoma of the parathyroid.

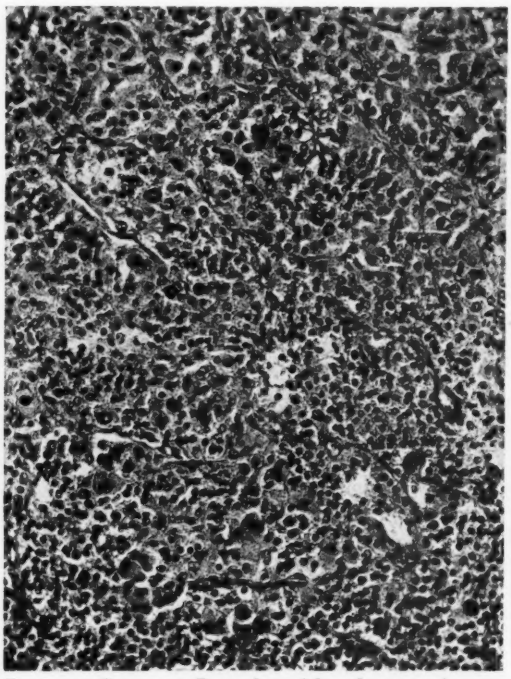

Fig. 5. Case v. Parathyroid adenocarcinoma grade 1. Both chief and oxyphil types of cell are present. The cellular arrangement is irregular and the nuclei are hyperchromatic and irregular in size and shape. Giant nuclei and mitotic figures are seen (hematoxylin and eosin × 180).

Case iv. A tumor was found lying behind the right lobe of the thyroid gland in the groove between the trachea and the esophagus. On removal it measured 3 by 1.5 by 1 cm. and weighed 5 Gm. A portion of the right lobe of the thyroid gland was also removed. The surgical pathologist reported the thyroid tissue as showing parenchymatous hypertrophy with regenerative hyperplasia and thyroiditis grade 1.

Microscopic examination revealed the tumor to be made up of large cells with clear cytoplasm. (Fig. 4.) The cells were arranged in masses although in some regions an alveolar arrangement was apparent. The nuclei were eccentrically placed, hyperchromatic and irregular in size and shape. Many nuclei had prominent nucleoli. No mitotic figures were seen. There were numerous small cystic spaces lined by these wasserhelle cells. Large endothelial-lined sinusoids were prominent. Regions of colloid with peripheral vacuolization were occasionally seen. There was no evidence of capsular invasion. No chief or oxyphil cells were seen. Because of the irregularity of the size and shape of the nuclei associated with the prominent nucleoli and the densely staining chromatin network, this tumor was considered to be a grade 1 adenocarcinoma of clear cell type.

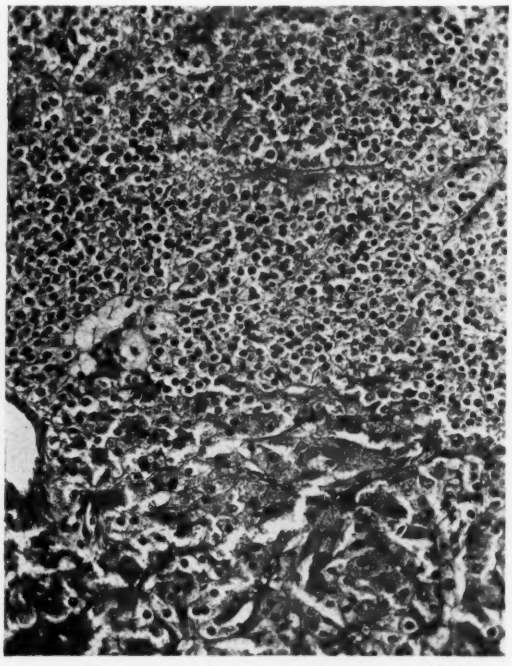

Fig. 6. Case viii. Parathyroid adenocarcinoma, grade 1. The contrast between tumor cells of the chief cell type and those of the oxyphil cell type is clear. The cellular arrangement is irregular and the nuclei vary in size, shape and staining power (hematoxylin and eosin × 180).

Case v. The parathyroid tumor was found extending substernally on the right side behind both the trachea and the esophagus. It was irregularly ovoid and definitely encapsulated and the capsule was anchored at only one point near the inferior pole of the right lobe of the thyroid gland. At this point the tumor received its blood supply from the inferior thyroid artery. The tumor was yellowish brown, making a marked contrast with the color of the thyroid tissue. The tumor was ruptured during removal but all the tumor tissue and the capsule were removed. Before rupture the tumor was estimated to measure 6 by 5 by 4 cm.

Partial removal of the right lobe of the thyroid gland was performed and the surgical

pathologist reported this to show cystic degenerating colloid and fetal adenomas in a hypertrophic parenchymatous colloid thyroid with thyroiditis grade 1 (on a basis of 1 to 4, in which 1 designates the mildest and 4 the most severe condition).

Microscopic examination of the tumor revealed most of the cells to be of chief cell type but there were scattered regions of oxyphil cells. (Fig. 5.) The cells showed an irregular alveolar arrangement. There were many endothelial-lined sinusoids. The nuclei were hyperchromatic and irregular in size and shape and the nucleoli were prominent. Mitotic figures and giant nuclei were seen. The evidence of malignancy was more definite in the oxyphil than in the chief cells. The tumor was considered to be a high grade 1 adenocarcinoma of the parathyroid.

Case vi. A tumor was found lying behind the right lobe of the thyroid gland midway between the superior and the inferior pole and attached to the thyroid capsule. The tumor was blackish brown. On removal it measured 2 cm. in diameter and weighed 5 Gm.

Microscopically, the tumor was found to be made up of large clear cells with an irregular arrangement. There were occasional pale oxyphil cells. There was great vascularity with large endothelial-lined sinusoids. The nuclei were deeply stained and varied grossly in size and shape. The nucleoli were prominent. There were tumor giant cells scattered throughout. Mitotic figures were frequently seen. The histologic picture was that of a higher grade of malignancy than that of the preceding cases and this tumor was classified as a grade 2 adenocarcinoma of the parathyroid, of predominantly clear cell type.

Case vii. The surgical and pathologic aspects of this case were presented by Mayo in 1936. A tumor was found on the right side of the neck, extending substernally into the posterior mediastinum and behind the trachea. It was soft, encapsulated and surrounded by a network of veins. On removal, it measured 6 by 6 by 5 cm. and weighed 101 Gm. The cut surface was chocolate colored and showed cystic regions. The surgical pathologist reported the tumor to be a grade 1 adenocarcinoma of the parathyroid.

Microscopically, the tumor cells were seen to be of the clear cell type and fairly uniform in size. There was one region of pale oxyphil cells. The nuclei varied considerably in size and shape and some giant nuclei were present. Many of the nuclei contained excessive chromatin. Mitotic figures and prominent nucleoli were occasionally seen. At some points there was apparent capsular invasion. The cellular arrangement was of diffuse type. Regions of pink-staining colloid with peripheral vacuolization were scattered throughout. This tumor was considered to be a grade 1 adenocarcinoma of the parathyroid.

Case viii. A tumor was found lying behind and elevating the right lobe of the thyroid gland. It was situated near the lower pole. On removal, this tumor measured 2.5 cm. in diameter and weighed 7.1 Gm.

Microscopic examination revealed the tumor to be made up predominantly of chief cells with an alveolar arrangement. There were also regions of pale oxyphil cells (Fig. 6) and large clear cells. The nuclei were larger and more hyperchromatic than those seen in the normal parathyroid gland and were irregular in size and shape. A few mitotic figures were seen. Throughout the tumor were clear spaces, some lined by endothelium and others by parenchymal cells. This tumor was considered to be a grade 1 adenocarcinoma of the parathyroid.

Case ix. At necropsy, a tumor was found in the neck near the lower pole of the right lobe of the thyroid gland. It was yellowish brown, measured 4 by 2 by 2 cm. and weighed 4.2 Gm. The pathologist reported the tumor to be a parathyroid adenoma.

On microscopic examination the tumor was found to be made up of chief cells with some regions of wasserhelle cells and other regions where the cytoplasm was of oxyphil type. The cells were for the most part arranged in a diffuse manner but in some regions there was an alveolar arrangement. The nuclei were large, hyperchromatic and irregular in size and shape. Nucleoli were prominent and mitotic figures were seen. The tumor was considered to be a grade 1 adenocarcinoma.

Case x. A tumor was found on the posterior aspect of the left lobe of the thyroid gland, near the superior pole. On removal, it measured 2.9 by 2.3 by 1.4 cm.

On microscopic examination, the cells of the tumor were found to be arranged very irregularly. Cells resembling chief cells, large, pale oxyphil cells and also wasserhelle cells were present. The nuclei were hyperchromatic and showed great variation of size and shape. Many

giant nuclei were present. Tumor giant cells and mitotic figures were seen fairly frequently. A few pathologic mitotic figures were seen.

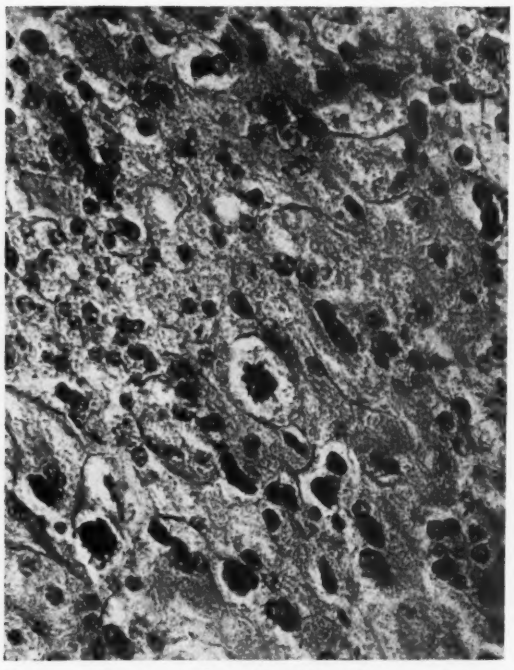

Fig. 7. Case x. Parathyroid adenocarcinoma grade 2. The cells are irregularly arranged. The cytoplasm of many of the cells contains oxyphil granules. The nuclei vary grossly in size and shape and are hyperchromatic. Giant nuclei are present and one cell is shown undergoing pathologic mitosis (hematoxylin and eosin × 400).

(Fig. 7.) There were numerous large sinusoids and hemorrhagic regions, often associated with pigmentation with an iron-containing pigment. This tumor was considered to be a grade 2 adenocarcinoma.

Case xi. A dumbbell-shaped tumor was found at the lower pole of the left lobe of the thyroid gland. It projected substernally. On removal, it measured 3.5 by 2 by 1.5 cm. and weighed 6 Gm.

Microscopic examination revealed the tumor to be made up of irregularly arranged clear cells and scattered oxyphil cells. Sinusoids and hemorrhages were prominent. There were regions of pink-staining colloid with peripheral vacuolization. The nuclei were large and hyperchromatic and markedly irregular in size and shape. Many mitotic figures and a few tumor giant cells were seen. (Fig. 8.) This tumor was considered to be a grade 2 adenocarcinoma.

Case xii. A tumor was found dorsal to the right lobe of the thyroid gland outside of the thyroid capsule. It measured 3 by 1.5 by 1.5 cm. and differed in color from the thyroid tissue. Removal was readily accomplished

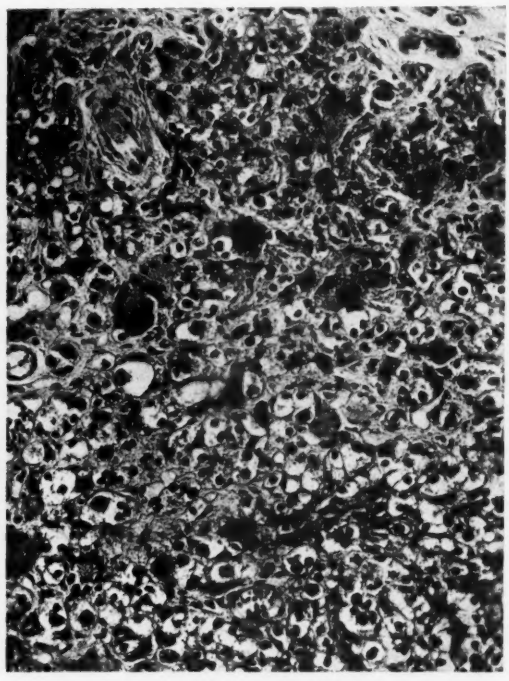

Fig. 8. Case xi. Parathyroid adenocarcinoma grade 2. Both clear cells and oxyphil cells are present and in a markedly irregular arrangement. The nuclei show gross variation in size and shape and staining power. Tumor giant cells can be seen (hematoxylin and eosin × 180).

after division of a branch of the right inferior thyroid artery.

Microscopic examination revealed a rim of normal chief cells partially surrounding the tumor. In the tumor the cells showed an irregular arrangement with regions of rosette formation and pink-staining colloid. No oxyphil or wasserhelle cells were seen. The nuclei showed densely staining chromatin networks and were irregular in size and shape and staining power. Some nuclei were distinctly granular and many showed prominent nucleoli. Occasional mitotic figures were seen. This tumor was considered to be a high grade 1 adenocarcinoma of the parathyroid.

Case xiii. A tumor was found situated at the inferior pole of the left lobe of the thyroid gland. It lay outside the thyroid capsule and received its blood supply from the left inferior thyroid artery. It was readily removed with its capsule. The tumor weighed 4.23 Gm. and measured 2.4 cm. in diameter.

Microscopic examination revealed the tumor to be made up of cells resembling chief cells, arranged diffusely. No oxyphil or wasserhelle cells were seen. The nuclei were larger than the nuclei seen in the normal parathyroid and stained more deeply. Nucleoli were not prominent but occasional mitotic figures were seen. In some regions the cells were arranged as a loose cellular network. Regions of pink-staining colloid with peripheral vacuolization were scattered throughout. A prominent feature was the invasion of the capsule by tumor cells. (Fig. 9.) This tumor was considered to be a low grade 1 adenocarcinoma of the parathyroid.

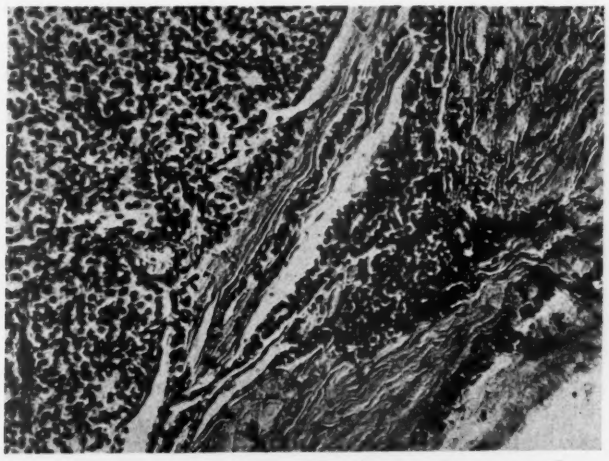

FIG. 9. Case XIII. Parathyroid adenocarcinoma grade 1. The tumor cells are invading the capsule (hematoxylin and eosin ×180).

CASE XIV. Exploration of the neck for a parathyroid tumor gave negative results. Subsequent exploration of the mediastinum through a sternal splitting approach revealed a tumor in the left anterior mediastinum. It was oval, encapsulated and readily removed. It weighed 5 Gm. and measured 4.5 by 2.5 by 1 cm.

Microscopic examination revealed a general alveolar arrangement of cells with a darkly staining nucleus and relatively clear cytoplasm. There were scattered regions of oxyphil cells and wasserhelle cells. (Fig. 10.) The nuclei were irregular in size, shape and staining power. The nucleoli were prominent and many nuclei appeared granular. Giant nuclei and mitotic figures were scattered throughout the tumor. This tumor was considered to be a grade 1 adenocarcinoma of the parathyroid.

REVIEW OF CASES WITH COMMENT

Weight of the Tumor. In ten of the fourteen cases, the tumor was weighed shortly after removal, before section and fixation. The average weight of the tumors in these ten cases was 18.2 Gm. The greatest weight was 101 Gm. and the least weight was 1 Gm. Castleman and Mallory found an association between the volume of the tumor and the severity of the

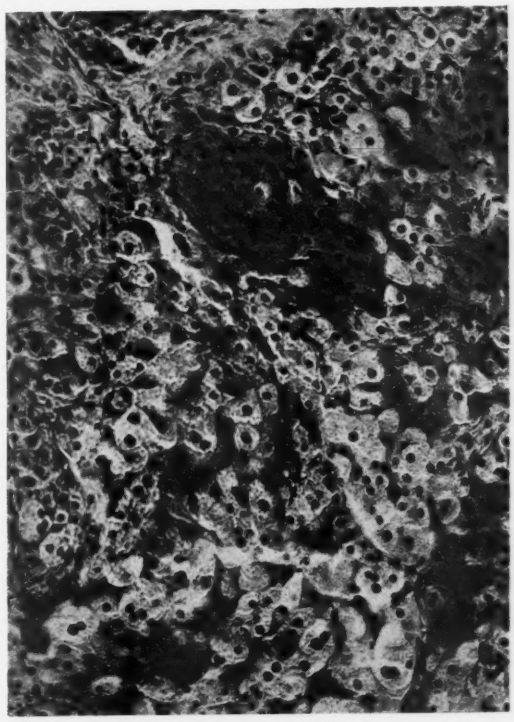

FIG. 10. Case XIV. Parathyroid adenocarcinoma grade 1. Chief cells, wasserhelle cells and clumps of oxyphil cells can be seen. The cells are arranged irregularly in this section. The nuclei are irregular in size, shape and staining power (hematoxylin and eosin × 180).

hyperparathyroidism as judged by the average preoperative concentration of calcium in the serum. The larger tumors were associated with higher concentrations of calcium in the serum. Cope has applied this finding when searching the neck for a parathyroid tumor. He stated that if the elevation of the level for serum calcium was minimal, the surgeon should realize that any adenoma would be small and perhaps difficult to find. On the other hand, if the concentration of calcium was more than 14 mg. per 100 cc. of serum the tumor should be large enough to be palpated or to displace other organs and be discovered readily. He also expressed the belief that the converse is true; if a small adenoma was identified in a patient with a moderate or high elevation of the serum calcium level, then a second adenoma should be looked for.

Table 1

THE RELATION BETWEEN THE WEIGHT OF THE TUMOR AND THE AVERAGE OF THE PREOPERATIVE VALUES FOR SERUM CALCIUM IN TEN CASES OF HYPERPARATHYROIDISM

Weight of Tumor, Gm.	Cases	Average of Preoperative Concentration of Calcium, Mg. per 100 Cc. of Serum
Less than 5	3	14.85
5 to 9.9	4	14.35
10 and more	3	14.3

In this series of ten cases, no proportional relation between the weight of the tumor and the preoperative value for serum calcium could be established. (Table 1.)

Position of the Tumor. Nine (64.3 per cent) of these tumors were situated on the right side of the neck or mediastinum and five (35.7 per cent) on the left. In one case the tumor was within the right lobe of the thyroid gland, was nodular and extended into the superior mediastinum. In the other thirteen cases, the tumor was outside the thyroid parenchyma, either attached to or free from the thyroid capsule.

In seven cases the tumor was situated at the lower pole of the corresponding thyroid lobe. In three of these cases the tumor projected through the superior into the posterior mediastinum. In one of these latter cases, the tumor lay behind the trachea and the esophagus. In four instances, the tumor lay behind the corresponding lobe of the thyroid gland midway between the upper and lower poles, while in one case the tumor was found behind the upper pole. In another case the tumor lay in the left anterior mediastinum and could be removed only after the sternum had been split.

In 1941, Cope reported that of forty-nine adenomas of the parathyroid he had found nine in the mediastinum (18 per cent); five (10 per cent) were in the anterior mediastinum, four (8 per cent) in the posterior mediastinum. In the present series of fourteen tumors, four were found in the mediastinum (28.6 per cent); one (7.2 per cent) was in the anterior mediastinum, and three (21.4 per cent) were in the posterior mediastinum.

Color. In all cases in which the color of the tumor was recorded before fixation in formalin, a brown, grayish brown or bluish gray color was noted. Absence of the normal parathyroid fat was the rule.

Capsule. All the tumors showed a definite capsule. In four instances (28.6 per cent) there was evidence of invasion of the capsule by tumor cells.

Type of Tumor. In this series there were no cases of generalized parathyroid hyperplasia. In no case were multiple tumors found although in Case 1 lobulation was marked. Careful attention to the cytologic detail in this series of fourteen tumors resulted in one (7.2 per cent) being classified as a benign chief cell adenoma. Ten (71.4 per cent) were classified as grade 1 adenocarcinomas of the parathyroid and three (21.4 per cent)

as grade 2 adenocarcinomas of the parathyroid.

Cytologic Features. Each of the three principal types of cells which have been described in the parathyroid parenchyma was seen in the tumors. Most commonly each of the cell types was found in each tumor; however, in one instance, a grade 1 adenocarcinoma, all the tumor cells were large, wasserhelle cells and the appearance closely simulated that of a hypernephroma. There did not appear to be any relation between the clinical picture and the type of cell predominating in the tumor.

Cytologic evidence of malignancy was seen in chief cells, oxyphil cells and wasserhelle cells. Such evidence included irregularity of the size and staining power of the nuclei, densely staining chromatin networks, giant nuclei, mitotic figures with pathologic mitoses and prominent nucleoli. In addition, there was absence of the normal parathyroid cell patterns with, in some instances, invasion of capsule and blood vessels by tumor cells.

In strong contrast to this finding of evidence of malignancy in 92.8 per cent of a series of parathyroid tumors causing hyperparathyroidism is the report of Cope on fifty-eight adenomas seen at the Massachusetts General Hospital. He stated that in no instance was there any microscopic evidence of malignancy. He asserted that carcinoma of the parathyroid is a rare disease and that in no reported case had hyperfunction been proved. In commenting on Snell's report (concerning Case VII in this series) Cope said, "The report of carcinoma in a gland giving rise to hyperfunction is not beyond question." Similarly Castleman and Mallory classified the tumor in Case 1 of this series as a benign tumor of glandular and cystic type. Jaffe also asserted that there was some doubt as to the possibility of a carcinoma existing in the parathyroid gland and criticized some of the cases reported as such. To the contrary are the reports of Quick and Hunsberger, Sainton and Millot, Petersma, Meyer, Rosi and Ragins and Gentile, Skinner and Ashburn. Meyer, Rosi and Ragins found unquestionable evidence of malignancy of the parathyroid in a case of hyperparathyroidism. After operative removal of the tumor the hyperparathyroidism abated but the tumor recurred locally and manifestations of hyperparathyroidism reappeared.

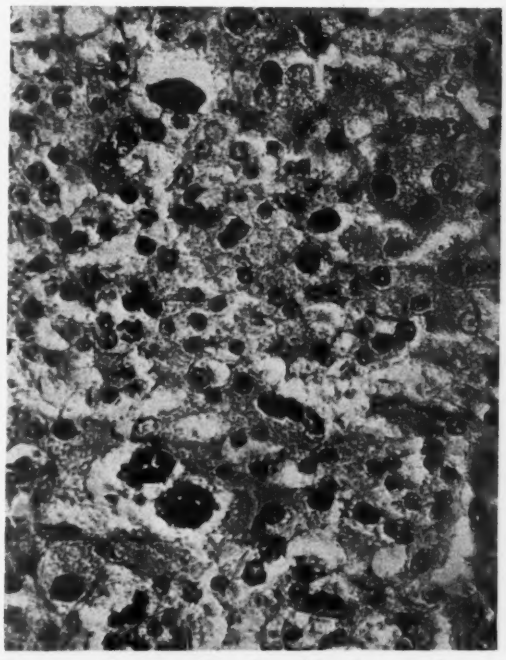

FIG. 11. Case X. Parathyroid adenocarcinoma grade 2 for comparison with Figure 1. The cells are irregularly arranged and many contain granular eosinophilic cytoplasm. The nuclei are hyperchromatic and show gross variation of size and shape. Giant nuclei are present. The tumor pictured in Figure 1 metastasized to a cervical lymph node. However, the histologic picture of the tumor pictured in Figure 11 is that of a greater degree of malignancy (hematoxylin and eosin × 400).

In the case reported by Gentile, Skinner and Ashburn, hyperparathyroidism recurred after removal of a malignant parathyroid tumor. This was relieved by operative removal of a metastatic growth in a cervical lymph node.

In no case in the series under study did metastasis or local recurrence occur, but the histologic features of the tumors, at least in the three cases showing grade 2 adenocarcinoma, were as frankly malignant as those of the tumors described

by Meyer, Rosi and Ragins and Gentile, Skinner and Ashburn (Figs. 1, 2 and 11.)

It seems probable that local infiltration and distant metastasis would have occurred more frequently were it not for the fact that these tumors, because of the hyperparathyroidism which they produced, were removed before local or distant spread had occurred. The average duration of the disease to the time of operation was 3.9 years. This is not a long period in the history of other low grade malignant tumors such as papillary adenocarcinomas of the thyroid.

The question is not a purely academic one. The malignant nature of the tumors makes their complete removal imperative. Cope, being skeptical of the development of carcinoma in the remnant of a parathyroid tumor, has stated that subtotal resection rather than complete removal of a tumor may sometimes be necessary in order to avoid life-endangering tetany. Because so many of these tumors are malignant and because the postoperative tetany can be controlled by administration of calcium and vitamin D we are unable to agree with Cope. Furthermore, although transient tetany was a troublesome complication in most instances in this series, in only one instance did persistent tetany occur.

SUMMARY

There have been many reports of nonfunctioning malignant parathyroid tumors and of functioning parathyroid adenomas. However, there have been only seven previous reports of functioning malignant parathyroid tumors producing hyperparathyroidism. In this paper fourteen cases of clinical hyperparathyroidism, proved to be due to functioning parathyroid tumors, are presented. In two cases the termination was fatal while in twelve, the results of operative treatment were excellent.

Stress has been laid on the widely divergent clinical pictures which patients who have hyperparathyroidism may present. It has been shown that any one symptom or sign—clinical, laboratory or roentgenologic—should not be regarded as decisive. Single findings of concentrations of calcium less than 12.5 mg. per 100 cc. of serum were encountered in 30.8 per cent of cases of proved hyperparathyroidism. Attention has been drawn to the importance of bearing in mind the relation between the serum protein level and the serum calcium level.

Depression of the value for serum phosphorus, measured as inorganic phosphate, is the rule in those cases without gross impairment of renal function.

The serum alkaline phosphatase level is elevated in proportion to the degree of involvement of bone.

The Sulkowitch test provides a rough estimate of the presence or absence of excess urinary excretion of calcium. Considered alone, it is not diagnostic of hyperparathyroidism.

The changes of bone in hyperparathyroidism appear to be an index more of the duration of the disease than of its severity.

According to our experience the incidence of renal lithiasis in hyperparathyroidism is about 60 per cent.

In thirteen (92.8 per cent) of the fourteen cases here presented the tumor showed cytologic evidence of malignancy. Two of these latter cases have been reported previously.

No correlation was found to exist between the weight of the tumor and the degree of hyperparathyroidism as measured by the concentration of calcium in the serum before operation.

The average weight of the tumors was 18.2 Gm. They were encapsulated and usually were brown. Four (28.6 per cent) were in the mediastinum, three being in the posterior mediastinum and one in the anterior mediastinum.

Cytologic evidence of malignancy was seen in chief cells, oxyphil cells and wasserhelle cells. Such evidence included irregularity of the size and staining power of the nuclei, a densely staining chromatin network, giant nuclei, mitotic figures,

pathologic mitoses, prominent nucleoli, irregular cellular arrangement and invasion of the capsule and blood vessels by tumor cells.

The type of cell predominating in the tumor did not appear to affect the clinical picture.

Stress has been placed on the necessity for complete operative removal of parathyroid tumors.

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MANAGEMENT OF POSTOPERATIVE URINARY TRACT COMPLICATIONS*

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WE have been afforded the opportunity of acting as urologic consultants for the Department of Surgery at the Lahey Clinic which does approximately 10,000 surgical procedures yearly. At this time we will attempt to outline some of the common problems we have encountered, presenting a general resumé rather than an exhaustive statistical study. All too frequently the postoperative urinary tract complications supersede the patient's original complaint, and upon the treatment of these complications may depend the outcome of the case. Therefore, even though valuable contributions to the subject of postoperative urinary tract complications have been made in the literature, a review seems indicated.

COMPLICATIONS

The three most common complications which still plague the general surgeon are *postoperative urinary retention*, *postoperative urinary tract infection*, and *postoperative urinary suppression*. These are frequently related and may occur in any order, but often develop in the order given.

Postoperative Urinary Retention. Since postoperative urinary retention may be dependent upon the anesthesia, the type of anesthetic, its depth and length are important. It is generally recognized that marked depression of sensory perception from any anesthetic permits vesical distention; and it would seem that local field block, spinal and inhalation anesthesia, in the order given, least affect the ability to urinate. At the Lahey Clinic, the use of inhalation anesthesia is limited to head, neck and chest cases, spinal anesthesia being employed for all abdominal and lower extremity operations. However, small amounts of inhalation anesthetic are given if apprehension occurs. A recent survey at the Clinic showed that 17 per cent of patients had to be catheterized after anesthesia.

In pelvic surgery the denervation of the bladder and the relocation or final malposition of the bladder constitute a well recognized factor. The distortions of the bladder seen on the cystogram and on cystoscopic examination, particularly after hysterectomy, advancement procedures and interposition operations are so definite that one is surprised when the patient can urinate at all. (Fig. 1.)

Removal of the lower bowel allows definite bladder distortion. (Fig. 2.) With removal of the rectum, the bladder loses its posterior support and practically hangs from the bladder neck down into the hollow of the sacrum. A definite acute angle is formed by the posterior urethra or vesical lip and the floor of the bladder. In many instances, the trigone is unable to correct this angle; and the detrusor muscle, moving about in space, so to speak, with no fixation of its base, is only weakly effectual. This malposition, with only minor disturbances in the balance of the autonomic nervous system, predisposes to urinary retention. This bladder difficulty is much more frequent and severe in the presence of even the slightest amount of prostatic enlargement; and since men in the age group in which prostatic enlargement is most common also are most susceptible to carcinoma of the rectum, many of these patients fall to the care of the urologist.

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We have proved by cystometric determination, and numerous other investigators have done likewise, that these bladders demonstrate such changes as markedly

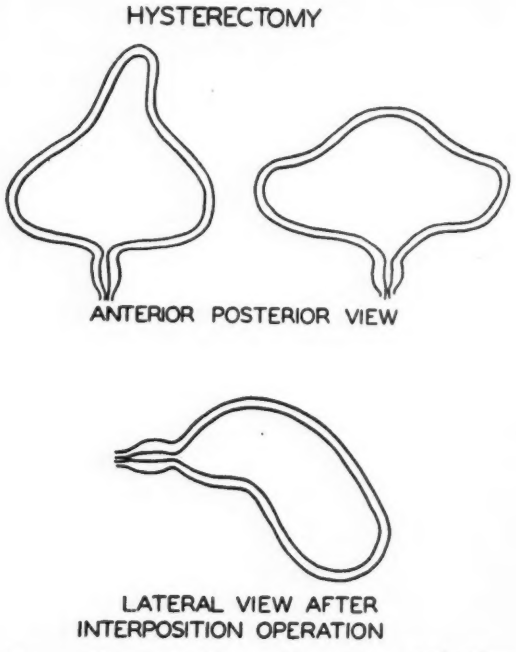

Fig. 1. Change in shape and position of bladder after hysterectomy.

diminished sensory component, increased bladder capacity, decreased intravesical pressure, and absence or definite diminution of the maximal voluntary pressure curve. (Fig. 3.) The anatomic and neurogenic lesions affecting the bladder often are happily transient, this organ having the faculty of adjusting itself readily to unusual positions and disturbances of innervation.

Postoperative retention due to true anatomic obstruction of the urethra is often either latent or overlooked. This is particularly true following repair of a hernia or a hemorrhoidectomy in a person past fifty years of age, when the reason for the hernia or hemorrhoids was not ascertained. Even on rectal examination, median lobe enlargement, contracture of the bladder neck, and urethral stricture may be overlooked.

Also, many obese persons lack the necessary abdominal wall component (Bauchpressor), and large ventral hernias or separation of the recti prevent them from tensing these muscles. It is frequently necessary to advise the nursing staff that if these patients are put in Fowler's position, they will be able to urinate.

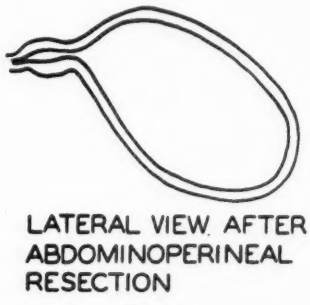

Fig. 2.

The *prevention* of postoperative urinary retention should be our first thought. Our impression is that if the house physician or the resident staff always appreciated that the urinary bladder undergoes decompensation just as truly as does the heart, patients would not be allowed to become distended so that their bladders held 1,000 to 1,500 cc. If the term "postoperative bladder decompensation" were attached more often to the consultation sheet, perhaps closer attention would be paid to the condition of the patient's bladder. If it were the custom more often for the physician to put his hand under the sheet and feel the patient's bladder, at least for the first forty-eight hours, fewer cases of postoperative retention would be encountered.

Postoperative decompensation may be said to occur when the bladder is allowed to reach the level of the umbilicus. In modern times, most patients receive parenteral fluids after abdominal surgery; consequently, in the first twelve hours 3,000 cc. or more of fluid may be given. In the absence of shock, the use of hot blankets and hot water bottles, with resulting loss of large amounts of body fluid, now is being omitted; consequently much of the fluid intake may be expressed in urinary output. It is manifestly impossible for a patient to void after eight hours of retention, since by this time the bladder is so huge that the bladder wall has lost its ability to contract in response to the

ordinary sensations. Normal persons taking 3,000 cc. of fluid have to void more often than every eight hours. To expect a patient who has had an anesthetic, has an abdominal incision, and is lying in bed, to void only once in eight, ten or even twelve hours, as is so frequently recorded in the postoperative instructions, needs no comment. The order to catheterize at intervals longer than six hours is distinctly unphysiologic.

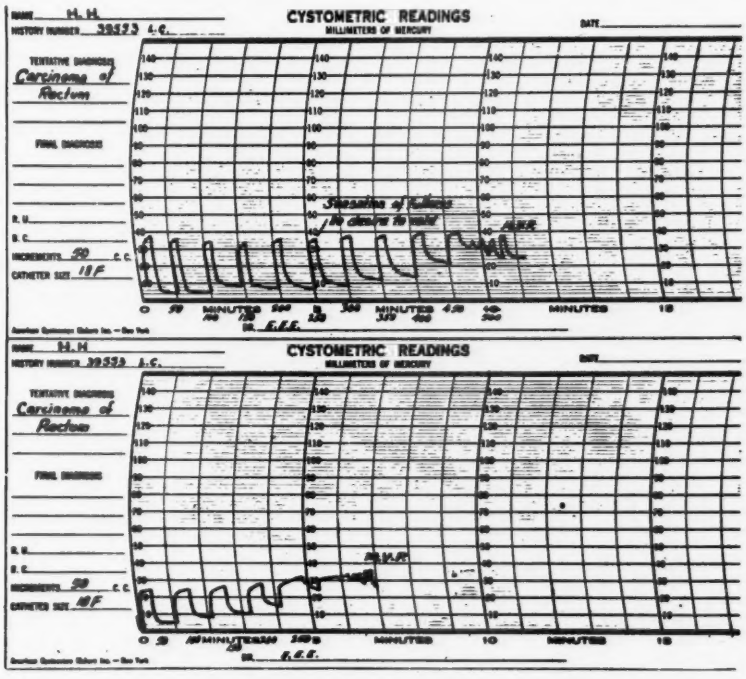

Fig. 3. Cystometric readings after abdominoperineal resection of the rectum.

The use of drugs is perhaps the most widespread method of combatting retention, those that stimulate the parasympathetic nerves being the most useful. The most familiar is prostigmine, used alone or in combination with morphine. Recently, Hand[2] of this Clinic has used the combination of prostigmine and morphine because of the recent reports of its potentiating effect. The addition of prostigmine, 0.5 mg., 1/130 gr., or 1 cc. of a 1:4,000 solution, to morphine, gr. 1/8, will result in therapeutic effects similar to those resulting from the use of morphine, gr. 1/4.

Our clinical investigation tends to confirm the laboratory findings to a moderate degree. In a recent series limited to gallbladder and stomach surgery, retention occurred in only approximately 6 per cent of the patients. Prior to this, retention occurred in 15 to 20 per cent of the patients. Furthermore, this combination (morphine, gr. 1/8, and prostigmine, gr. 1/130) by subcutaneous injection, relieves pain within only ten to fifteen minutes, produces an effect which lasts for four to five hours, and does not dull the sensorium too much. Because of its apparent value, it is now being employed routinely at the Clinic.

Doryl, an acetylcholine derivative, has also been employed; however, recently a death occurred in a young man in whom no other reason for death than the use of the drug could be found. The dose given was supposedly 0.25 mg. Rupture of the bladder in patients with diverticula or with marked degeneration of the bladder itself is within the realm of possibility.

The prophylactic instillation of various drugs into the bladder locally is an attempt to increase the irritability of the bladder and to overcome the depression of the sensory component produced by the anes-

thetic, postoperative medication and fear. The use of mercurochrome by Woodruff,[5] Helfert[3] and others is a more recent application of this.

Fig. 4. Excretion urogram after right ureteral ligation. The right side shows hydronephrosis and hydro-ureter. The left side is normal.

Our practice for the avoidance of bladder decompensation follows: The patient is catheterized every six hours until the residual urine is 60 cc. or less. After each catheterization, 2 oz. of ½ of 1 per cent aqueous mercurochrome is instilled. This method reduces the residual urine more quickly than intermittent catheterization without an irritant solution. If after twenty-four hours the residual urine is not reduced appreciably, the patient is placed on closed drainage with an indwelling catheter; and the bladder is irrigated every three hours with 2 per cent boric acid or 0.8 per cent sulfanilamide solution. Once having established the decompensated bladder, the patient is allowed to remain on closed drainage for a minimum of five days, and then is given a trial without a catheter and tested for residual urine every six hours as before. Usually one such course of management will suffice. In borderline cases, when the bladder is not lessening its residuum well enough, we have used 0.5 to 1 cc. of doryl one-half hour before catheterization as an added stimulus to the contractile power of the detrusor muscle. This is used, however, only in the absence of any obstructive lesion. Also, immediately upon starting the catheterization program, the patient is given 0.25 Gm. of sulfathiazole by mouth four times daily.

Under this plan of treatment, fluids can be forced without concern; and we have yet to see a resulting upper urinary tract complication. This plan has been invaluable in those patients with advancement of the bladder or cystocele-correcting procedures. In the past some of these patients have broken down their repair because the residual urine was not checked or the bladder was allowed to distend to an enormous degree because the ability of the bladder to empty itself was not determined.

A patient who has undergone abdominoperineal surgery or who is in the age group of prostatic disease, after two trials of this management, is given a cystoscopic examination and any bladder neck obstruction is corrected. If no mechanical obstruction is found, cystometric studies are done to detect an undisclosed nerve lesion.

In the male with a urethral stricture, the passage of a filiform into the bladder and tying it in place is often of assistance. This method, which is applied by older urologists, is unknown or unappreciated by many of the younger men. It results in less damage to the patient than forcibly dilating a stricture to allow spontaneous voiding or to enable a catheter to be put in place.

Postoperative Urinary Tract Infection. It seems inevitable to link postoperative urinary tract infection with bladder atony or a persistent undiscovered residual urine. The type of surgical patient in whom this is most frequent and is least appreciated is the woman with a large cystocele. Many multiparous women carry a bacteriuria which flares up into a clinically evident urinary tract infection on bad postoperative management.

Sulfonamides in small prophylactic doses, totalling 1 Gm. a day, should be used more often, since this amount will control postoperative urinary tract infection. When we are consulted preoperatively concerning a patient with prostatic hypertrophy who will undergo surgery for a malignant condition elsewhere in the body, which has taken precedence over the prostatic condition, we prescribe 0.25 Gm. of sulfathiazole four times a day. If the patient is easily upset by this drug and especially if he is undergoing surgery of the gastrointestinal tract, the use of enteric-coated tablets materially avoids the nausea which, despite popular belief, does not always seem to be due to a central effect. For the patient in whom both forms of sulfathiazole elicit a reaction, sulfadiazine or sulfamerazine may be prescribed, in the same dosage. When all the sulfonamides are attended by reaction, mandelamine (0.5 Gm. four times a day), although less effective, will be useful.

Postoperative Urinary Suppression. The fact that true partial or complete anuria is present rather than retention must always be established. The classification into prerenal, renal and postrenal forms permits of a workable clinical arrangement.

The search for loss of excessive body fluids through vomiting, hemorrhage, diarrhea and gastrointestinal fistula is required. Periodic blood pressure readings to rule out shock, vascular accident and coronary occlusion, of course, must all be kept in mind. Post-transfusion anuria in the presence of hemorrhage and shock may confuse the picture greatly so that a definite diagnosis at times is difficult. The widespread use of the blood bank demands adequate crossmatching. Reaction in Rh-negative recipients given repeated transfusions from Rh-positive donors is now an appreciated cause of anuria.[4] In this situation, the treatment consists of transfusion with Rh-negative blood, and the use of alkali to prevent precipitation in the renal tubules.

Chronic Bright's disease always has seemed to us a dangerous condition in an obese person undergoing abdominal surgery and having some degree of postoperative shock. Recently an obese male with chronic Bright's disease was in partial shock following cholecystectomy and developed oliguria. The urine had a low specific gravity; and the blood pressure, which previously had been elevated, approached normal. It was only after the use of 50 per cent glucose and intravenous fluids that the urinary output became normal. Even with a diminished output, the fluid intake must at all times be maintained. Also, in the presence of edema, so long as there is output, fluids must be continued. We have not recommended or seen any benefit result from renal decapsulation and denervation.

We are now all familiar with the notorious offenders, namely, the sulfonamides, as a cause of anuria. Our experience indicates that if sulfadiazine is given without adequate fluids to a patient with some degree of acidosis or an acid urine, some degree of diminished urinary output must be expected. In postoperative patients without too many factors to be controlled, sulfathiazole seems to be more soluble. Our consultations for this form of diminished output have been almost always for sulfadiazine and rarely for sulfathiazole; however, it would seem that no trouble should result from either in the small dosage of 1 Gm. a day. We have had to cystoscope and catheterize the ureters of five patients with crystallization of sulfadiazine, but have avoided this complication in quite a few other patients by an increased intake of fluid and alkalinization. If the non-protein nitrogen is not approaching a critical level, the use of parenteral fluids may ward off manipulation.

Under postrenal causes for diminished output of urine, we are impelled to discuss surgery in the pelvis. Hysterectomy is a notorious offender in injuries to the ureter. Bilateral ligation of the ureters is a tragic occurrence if allowed to go unrecognized. Our experience in injury to the ureter during gynecologic surgery is limited to the

unrecognized ligation of a ureter which finally established a communication to the vagina on the eighth postoperative day. The management of this case is representative of the plan we had long entertained for dealing with such a situation. Since this woman had undergone a hysterectomy, the strain of childbearing was past. After proving by excretory urograms that the other kidney was normal (Fig. 4), and by attempting to catheterize the suspected side and establishing the site of the difficulty, a nephrectomy was done. The patient's postoperative stay in the hospital was prolonged, possibly two weeks; however, she was not subjected to returning for a hazardous plastic operation and the many necessary cystoscopic trials for patency thereafter, which might also have been an extreme economic burden.

Many unilateral ligations occur in patients in whom the anatomy has become distorted by intraligamentous fibroids and cysts. This type of pathologic condition must be kept in mind when a stormy course follows pelvic surgery.

Over a period of years we have followed several patients with endometrial implants on the ureters in whom some injury to the ureters during pelvic surgery was thought likely. We have noted narrowing of the ureters, but this did not progress, as interpreted by the excretory urogram. We believe that attempts to dilate an apparent narrowness might lead to an intractable upper urinary tract infection.

We would like to interject a comment here in regard to the ureteral atony and ureterectasia which result when large segments of the ureter are exposed, especially in lower bowel surgery, and the importance of avoiding this procedure if possible.

It is instructive to review a case in which a ureter was cut purposely by Dr. R. B. Cattell of our staff when removal of a section of the ureter was necessary because of involvement by a carcinoma of the rectosigmoid. When the ureter was cut, a No. 12 soft rubber catheter was passed down the distal segment and up into the proximal. An end-to-end anastomosis was done by tacking the cut ends together with interrupted fine catgut sutures. An indwelling catheter was placed in the bladder, as is customary in all patients undergoing this form of surgery. The posterior wound was drained and since this was adequate, no other drainage was provided intra-abdominally. The patient's postoperative course was not unusual. On the twelfth day a cystoscopic examination was done and the ureteral splint was removed. On checking the urogram three months later, only the slightest dilatation of the ureter in an otherwise normal upper urinary tract was found.

We must confess that in the light of present knowledge we would have allowed the ureteral splint to remain in place at least three weeks and preferably longer. If any complication had marred the removal of this catheter, we intended to remove the kidney so as to shorten the patient's postoperative course and not subject him to additional manipulation when the eventual prognosis at best was not promising.

We recognize that prolonged ureteral splinting and complicated plastic procedures may at times not be feasible, and that the surgeon is confronted with the problem of attempting a surgical bridge for the patient's postoperative course at a time when the question of his recovery is critical. Dr. Cattell's idea was that the simplest form of establishing ureteral continuity was demanded, and that if the patient could be tided over until his second or third week, this result would be achieved; and that any other radical surgery then could be handled by the urologist without adding an unnecessary burden in the first critical days.

We recently were consulted in another case for advice regarding the severance of a ureter which was involved in a carcinoma of the rectosigmoid. The ureter was ligated and dropped back into place. The patient had had a urinary tract infection, and he was placed on more than the usual amounts

of sulfathiazole postoperatively. The resulting hydronephrosis and fever were controlled until the second week when a nephrectomy was necessary because of fever, flank pain and lack of progress. The important point is that this patient was tided over his acute surgery and management of his complicating urologic problems was simplified.

Large Bowel Surgery. Several years ago, one of us (E. E. E.)[1] analyzed 750 cases of large bowel surgery, because of the high incidence of associated genitourinary complications. Nearly all the patients had a malignant condition, and because the operability rate of carcinoma of the rectum was calculated to be 85 per cent, it was assumed that the extensive lesions and the poor risk would produce a comparative rise in the genitourinary complications. All patients undergoing abdominoperineal resection, as well as many of those with sigmoidal and colonic lesions, had a catheter in place and were on constant drainage. Since it was impossible to determine preoperatively the type of procedure necessary, most of them were handled by inlying catheter.

From this study it was concluded that genitourinary complications after large bowel surgery are most common following removal of the rectal portion, 74 per cent of the whole group having postoperative difficulty in emptying the bladder. This is perhaps due to the fact that the portions of the genitourinary tract most frequently involved by carcinoma of the rectum and sigmoid are the prostate gland and the bladder. In five patients in whom resection had been performed, the process invaded the prostate gland after operation and produced obstruction which necessitated resection of the bladder neck. These complications may be so serious that they definitely prolong the patient's convalescence.

The patients with postoperative difficulty in emptying the bladder seem the most important. Of the fifty-three males who had resection of the rectum, thirty-two had sufficient difficulty to require revision of the bladder neck. All these patients had some symptoms prior to operation. The question of preoperative correction of the vesical neck had been raised previously, but we believe that postoperative correction is wiser since some of these patients with difficulty preoperatively may get along sufficiently well after bowel surgery to avoid two major surgical procedures in quick succession. Also, the removal of obstruction does not eliminate possible paralysis of the detrusor muscle, which nearly all these patients have to some degree after abdominoperineal surgery. Another factor is that the reaction following transurethral operations done after the abdominoperineal resection is much less, due to destruction of the blood supply to the prostate gland and the walling off of the lymphatic system. Definite bladder paralysis for longer than two months has occurred in only two patients; and in only six patients of our series was it necessary to maintain tidal drainage longer than three to four weeks. A suggested clinical classification of detrusor paralysis follows:

1. Pure detrusor paralysis from parasympathic denervation
   (a) A mild form cystometrically evident in large numbers of patients the first week following operation
   (b) A severe form necessitating prolonged tidal drainage, present in a small number
2. Mixed forms of detrusor paralysis in combination with:
   (a) Vesical neck obstruction
   (b) Almost complete loss of anatomic support and lack of fixation
   (c) Inherent resistance in the male urethra.
3. Vesical neck obstruction alone

Ureteral dilatation which apparently is not due to obstruction at the bladder neck has been noted in some of these patients. While isolation of the ureters is important to the general surgeon, needless dissection is a mistake, since it deprives

the ureters of blood supply and also denervates them.

The abdominoperineal patient routinely is handled by an inlying catheter. The urethral catheter of the Foley type is inserted the night before surgery and closed drainage is instituted. In the patient in whom difficulty is anticipated, the inlying catheter should not be removed until he is able to sit up. Many of these patients incur damage to the upper urinary tract in the form of pyelonephritis at the time of removal of the catheter. Since this is the crucial period, these patients must not be allowed to become overdistended. Patients voiding small amounts, even though they are comfortable, should be catheterized and if more than 2 oz. of residual urine is present, the catheter should be reinserted for a few more days. The usual plan of catheterizing patients with ordinary postoperative retention should be followed, and thus the bladder is not allowed to revert to complete atonicity. Many times the patient's clinical progress in regard to the genitourinary system may be retarded during this crucial period by a co-existing infection, which may be exceedingly stubborn.

Many patients, especially males, even with an adequate bladder neck, continue to have residual urine. We have been impressed with the fact that the removal of the slightest amount of bladder neck obstruction will allow such a patient to urinate freely. Since many patients continue to have pyuria after dismissal, although they have no symptoms, persistent urinary check-ups should be done and small doses of urinary antiseptics prescribed.

SUMMARY

The three most common postoperative urinary tract complications are retention, infection and suppression. The causes of these manifestations are reviewed, and our experience in their management is presented. Particular attention is given to the urinary problems attending pelvic and large bowel surgery. The consulting urologist to a busy surgical service can render invaluable aid by relieving the clinical picture in a patient already overburdened with other serious difficulties.

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MOTION STUDY IN SURGERY

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OVER a period of years, increasing efforts have been made to set standards for the practice of surgery and its various special divisions. Surgical organizations and specialty boards have made steady progress in recognizing and certifying qualified specialists. While every surgeon cannot be expected to be of outstanding ability, still there is a certain degree of proficiency which is essential to the practice of surgery. This raises the query as to what constitutes a good surgeon and as a corollary the question as to what constitutes good surgery.

Even in professional athletics it is not easy to define the qualities which make outstanding performers. In golf and in tennis it is that intangible something called form; in horse-racing it is called class. All players on a ball team are not stars but must have sufficient talent for the league in which they play.

Good surgery requires thorough examination, accurate observation, a wide knowledge based on experience and carefully planned and timely intervention aimed at the greatest possible restoration of normal function.

A good surgeon is endowed with personal aptitude, mechanical dexterity, sound judgment, and ability to make rapid decisions in the face of unexpected situations. These qualities are fundamental and must be supplemented by adequate basic training and thorough knowledge of technical procedure.

This study is concerned only with the competent surgeon. It is assumed that he knows what to do and how to do it. It considers, therefore, not the choice of operation or methods but rather is concerned with mechanical factors, motions, materials, and their use.

Because of the introduction of so many variations into surgical procedure during the past half century, it is time to stand off and survey the whole picture, appraising individual factors in their relation to the entire pattern.

The trend toward simplification of equipment and procedure had advanced rapidly and further acceleration is current under the stimulation of war time conditions. Shortage of professional man power and limitation of supplies can be largely overcome by application of sound principles of standardized practice.

Work simplification has been a major factor in industrial management since the pioneer time studies originated by Dr. F. W. Taylor in 1881 for the purpose of rate setting. Subsequently motion study was developed by F. B. and Lillian Gilbreth for the purpose of improving methods. In 1915, F. B. Gilbreth made an analysis of hospital efficiency from the standpoint of a non-medical process engineer. It had been his belief that because of the importance of the work and because of the specialized medical training of the operating personnel he would find here the greatest perfection of method and efficiency of any technical organization.

After a study of surgical methods in use at that time, he reported having found a waste so enormous that it was unequalled in his experience. Since that time only a small number of papers have been contributed on this subject. Progress has been made, however, despite the fact that the medical mind instinctively avoids industrial and commercial standards. For this there is no valid reason. The object of all work simplification and standard practice studies is to consider all factors involved

and to determine the one best way to undertake a procedure. These factors include standardization of equipment, economy of motion, prevention of physical fatigue, and shortening of the time factor. The latter is to be in no way construed as a plea for speeding up operative procedure. It is utterly impossible to standardize in minutes the time required by a varied group of men for the performance of an appendectomy. It is similarly not necessary to undertake an appendectomy with a scissors, hemostat, needle and sutures as has been done. Oversimplification of equipment has no merit of itself; nor has the development of high speed technic if such a method sacrifices accuracy and thoroughness or induces undue fatigue.

It has been said that a man who will not consider change is an old man. The study of an assortment of surgeons of various age groups shows that at an early stage of their careers they have become victims of habit. Since change usually runs counter to established custom, mental habit is the basis of resistance to change. Like the door to a room, the mind permits entrance of new ideas only when it is open.

The sturdy individualism of surgeons in general makes distasteful a constant repetition of the same process and one wonders what would be the reaction of the surgeon were he to become a cog in the great wheel of industrial organization and spend an entire day punching drill holes in pieces of sheet metal. Yet, by such methods has our great supremacy in industry been founded.

When a new idea or method offers an increase in efficiency or the same efficiency with less loss of motion, it should be tried out at once. Revamping of surgical methods requires a mental house-cleaning on the part of the crew. It involves close scrutiny of existing methods with a view to their efficiency, simplicity and economy. It is obstructed largely by the lack of understanding of the value of such work and by the natural resistance to change from established habit.

One effective method of overcoming resistance is to subject objectors to a time and motion study of their work. The results are often instructive and convincing.

The object of this study is to analyze present methods and to suggest changes which will permit surgical operation to be accomplished with the smallest number of instruments, with the simplest motions, and in the shortest practicable time. In industrial processes a similar objective but different products are concerned. Industrial time and motion studies deal with a great volume of uniform products, so that the production process is purely repetitive. On the other hand, the human body is not stamped in a mould. It is living tissue in which allowance must be made for variation of structure both in health and disease. Nevertheless, accuracy and efficiency can be improved by a study of mechanical methods and their application to the science of surgery. It is estimated that 30 to 70 per cent of man and motion capacity are ordinarily not utilized in industry. Motion studies made over a period of several years indicate that a similar situation exists in surgery.

Mechanical methods should be reviewed in an attempt to determine whether any step should be omitted entirely, whether any individual habit motions are being perpetuated and whether any steps can be simplified without loss of accuracy. No attempt is made to rigidly limit technical motions for the sake of uniformity alone. Mechanical methods should be surveyed from the standpoint of simplification of setup and reduction of excess motions and consequent fatigue. Speed results from long practice due to familiarity with instruments and the development of habits of sequence, but it must not be attained at the expense of increased mental strain. The fastest method is not necessarily the best method and may not always result in a saving of time; but, in general, reduction in time consumed, if accomplished without added effort, will reduce the incidence of fatigue and improve the result. The surgeon and associates should be so welded into a

unit that their process reactions are standard for the team which they form. The equipment must be correctly placed, the tools must be comparatively few, arranged in obvious sequence, and should be handled with the easy familiarity of long use.

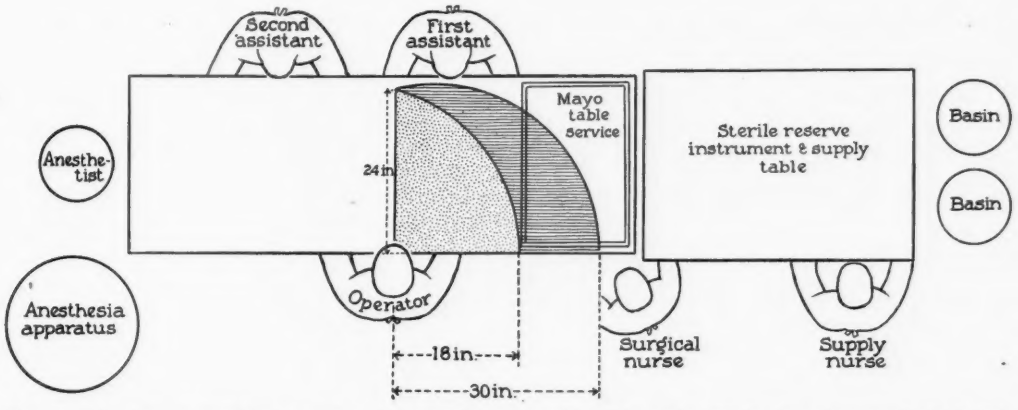

Fig. 1. Maximum working arc for right and left hands, right side. Right hand area shaded; left hand area stippled. Use of hands within these areas does not involve reaching or twisting body. Note that equipment is set up in straight line assembly.

The focal point of every operation is the surgeon, and all activity must radiate from that central point. It is essential that equipment and assistants be coordinated to permit direct and rapid action without hesitation, delay or obstruction.

Universal fundamental laws have been developed and proved by investigators in the industrial field. These laws are axiomatic and may be adapted to the practice of surgery.

Mechanical methods in surgery, as in industry, may be divided into two general classes: (1) Those concerned with set-up and equipment, (2) Those concerned with motion activity. The laws involving set-up and equipment can be reduced to four:

1. Instruments should be the simplest in design and fewest in number that will permit carrying out of the entire procedure. One of the bugbears of modern surgery is the multitude of specially designed instruments with slight variations. This is a costly and confusing practice. Skill is acquired and dexterity improved by constant practice with a few tools. Even the golf associations have found it necessary to limit the number of clubs which may be used in tournament play. Equipment already owned should be used whenever possible and new instruments should be added only when they perform a real function.

2. Locate the most frequently used materials within normal reach and in position which permits easy grasping. Three phases are involved in the use of instruments: acquisition, use and disposal. In setting up the instrument table it is important to provide definite and fixed stations for instruments and materials which should be within reaching range of the person who is to handle them. More frequently used instruments should be most accessible and should be placed within the normal working arc. This includes a semicircular area within reach of the forearm. (Fig. 1.) Less frequently used instruments may be located within the maximum working arc,

Table 1
Relative strength of fingers, hands and arms

	Pull in Lbs.	10 Lb. Pull Relaxes in
Thumb	15	30 sec.
Index finger	19	45 sec.
Middle finger	22	45 sec.
Ring finger	15	15 sec.
Little finger	12	5 sec.
Wrist	25	90 sec.
Forearm	140	22 min.

an area reached by the fully extended arm. Instruments placed outside that range must be handled by a second person, otherwise the element of clumsiness will enter. Instruments should be prepositioned on the table and should be separated sufficiently from adjacent objects to permit easy finger grasping. Curved hemostats may lie flat but flat instruments should be elevated on one end or stood up in a bowl for quick pick up.

These principles apply to the handling of instruments by the surgeon and assistants as well as to the nurses in charge of service and reserve supply tables. The number of instruments on the service table should be small and should be such as are used regularly. Those less frequently used may be kept on the reserve table which holds extra sponges, duplicates of the commonly used instruments and those which are used only infrequently. An instance was noted in which rake retractors were set up on the supply table in a hundred consecutive operations without ever being used. Obviously they were improperly located and should have been on the reserve table if used at all.

Each instrument should be disposed of as its use is completed and the operating table itself should always be free of instruments and sponges. The operating table is not an instrument table and should not be used as such. There should be designated on the service table a specified place for the disposal of soiled instruments. A folded towel may be placed in the front center of the service table and as soon as a soiled instrument is deposited in this area it is removed by the instrument nurse, cleaned and repositioned or discarded. It has been found helpful to keep on the same table a small deep cup for the reception of used needles and when each needle is deposited in the cup it is acknowledged by the table nurse who calls, "needle," a rule rigidly enforced. An orderly table is a pretty accurate index of the experience and ability of the operator and the co-ordination of the crew.

3. Arrange instruments in proper sequence and so prepositioned as to eliminate or reduce the search, find and select factors. Placement of instruments should be carried out with regard to the order and frequency of their use. The extremes to which this may be extended is illustrated by the celebrated surgeon, now gone, whose operating crew spent hours setting up his instrument tables so that each instrument was placed in the order of its proposed use and no instrument was ever used a second time. This necessitated the use of hundreds of instruments in complicated cases and was carried out to the extent of using separate needles and thread for each of the closely placed interrupted skin sutures. Such lengths of caution are unnecessary and only clutter up the tables. An extra knife for skin incision is essential, as any knife which has penetrated the deep bacteria bearing layers of the skin should be discarded to prevent bacterial implantation in the uninfected deeper layers; but instruments not contaminated may be used again.

Handling of instruments should involve the least possible conscious effort. This presupposes an unvaried location of instruments in positions of natural sequence so that the hand automatically picks up or receives the instrument in a position ready for use. This should be accomplished without taking the eyes off the field of operation. With a well trained and permanent operative crew this is a simple matter; but when assistants are being frequently changed, it becomes necessary to use some means of communication. Hand signals of a not too complex type answer satisfactorily, but in an ordinary operation such signals will seldom be required. When signals are used they should simulate the shape or function of the instrument called for, and it is unnecessary for signals to attain the complexity of a Morse Code. Twelve hand signals have sufficed to cover the most commonly used tools and all others are called for by name. (Fig. 2.)

4. Operating room equipment should be placed so as to provide fixed stationary positions for the personnel. It is essential that walking about be kept at a minimum during operation. Fixed positions save time and reduce the danger of infection. A single circulating supervising nurse should be the only one to move about and her services should be necessary only during preparation, after completion of the operation or when special supplies and equipment are needed.

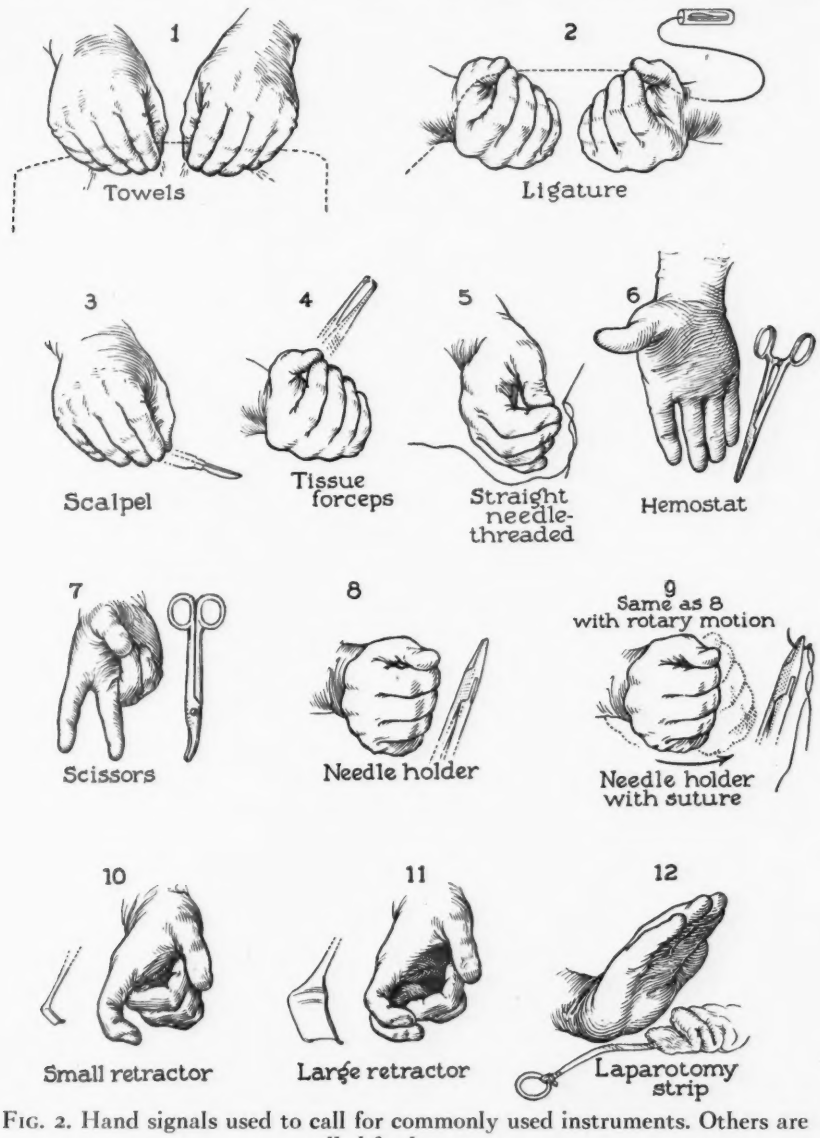

FIG. 2. Hand signals used to call for commonly used instruments. Others are called for by name.

Study of operating and supply table set-up shows many kinds in use. Lawrence and Berry designed a circular or arc surgical assembly based on the range of normal grasping areas. Although theoretically an ideal plan, the system seems to restrict the free area about the operative field when more than one surgical assistant is used, and the supply nurse seems to be placed dangerously near to the anesthetist. Familiarity with the arrangement might well accustom one to its use but it requires the installation of specially designed tables, a handicap which procludes its general acceptance at this time.

Of the many arrangements tried out, a straight line assembly has proved most satisfactory. The operating and supply

tables are set up end-to-end and two basin stands are placed at the far end of the supply table. A small adjustable service instrument table of the Mayo type is placed above the feet of the patient. The surgeon stands to the right of the operating table with the first assistant directly opposite. The second assistant may be stationed on either side as circumstances warrant. The table nurse stands to the right of the surgeon and directly in front of the small instrument table. The supply nurse is at her right, directly in front of the reserve supply table. This gives the surgeon unobstructed access to the instrument table with his right hand and leaves the disposal area within reach of his left hand. The nurses, standing side by side, always face the sterile instrument and supply tables and are out of the way of the other members of the team. (Fig. 1.)

5. Provision should be made for adequate lighting, and the height of the tables should be such as to minimize reaching and bending. The operating table should be of such height that no one is obliged to lean over, a fault which quickly induces fatigue and lessens muscular efficiency. The patient should be so placed and the table so tilted as to take advantage of the forces of gravity. Thus, in pelvic surgery the Trendelenburg position will permit cephelad displacement of the small intestine which in the erect position is carried entirely within the pelvis. Reversed Trendelenburg position with a dorsal lift will rotate the liver anteriorly and do away with the necessity for liver traction in exposing the gallbladder. Left lateral tilting of the table will displace the intestine and make exposure of an adherent retrocecal appendix a simple instead of a difficult maneuver.

Provisions must be made for adequate lighting, as good illumination is a prerequisite to satisfactory visual perception. Light must be glare-free and provide a focusing device to illuminate deep areas within the body. It must provide for emergency current in case of current failure and must be safe for use in the presence of explosive anesthetic gases.

The object of process study is to find the fewest motions which will do a given piece of work in the best way. Six laws are applicable to Motion Activity:

1. *Delay factors must be eliminated or reduced to a minimum.* Analysis of motion processes should provide a basis for simplifying work and eliminating factors which hinder, obstruct or delay its completion. Each step is considered in the light of what is being done, why it is being done, its relations to preceding and subsequent steps and to the entire operation.

Circumstances sometimes make delay inevitable but most causes of delay are avoidable. These result from mechanical failure, faulty choice of method, or personal ineptitude.

Delay due to personal shortcomings may be due to unfamiliarity with a set technic, lack of surgical judgment or inability to make mental decisions with necessary alacrity. The last manifests itself by a hesitant and indecisive approach and by deviation or shifting of the point of surgical attack from one place to another without good reason for such change of front.

Fatigue results from incorrect posture, long continued fixed traction, and from the use of cross arm motions beyond the normal work range. Stooping and twisting of the body are common errors of posture and the greatest single factors in wearing down physical reserve. Body twist occurs almost always when a surgeon crosses his arms beyond the normal working arc instead of using the other hand to transport instruments. It is permissible to cross either arm in front of the body within normal range. Beyond that the instrument should be picked up with the left hand and transferred to the right in an interrupted straight line motion or the instrument should be passed by the table nurse to a point within the normal forearm range.

The backs of the operating crew may be assumed at all times to be potential danger

areas and must therefore be kept away from all sterile materials. Turning the back to the table to explore the gallbladder with the left hand is an example of faulty technic. Placing assistants so close to each other as to have elbows coming in contact or placing them within close range of the anesthetist may break the entire chain of aseptic technic. The practice of resting the weight of the forearms and hands on the body of the patient is common and should be carefully avoided. Attention is forcibly called to this habit when abdominal surgery is performed under infiltration anesthesia.

Delay due to mechanical failure results from improper arrangement of equipment, faulty choice of handling of instruments or incorrect distribution of work between the operator and his assistants.

Work processes should be so arranged that the surgeon is spared all steps which can safely be taken over by his assistants. Ligation of vessels in non-vital areas may be done by the assistants and these procedures may be so spaced that the work of the operator is not continuous, thus giving him a few moments of respite while they are being taken care of. Such rest periods definitely reduce the fatigue factor. Too often the operator forgets the weariness involved in maintaining long continued traction. On rare occasions when such traction is necessary a change of hands holding the retractor will lessen fatigue.

Delay results also from failure of method. Here the offending factor may be a wrong choice of method or a lack of direct and continuous execution of an otherwise satisfactory method.

It is desirable to complete any operation in the shortest time required by the individual operator. One surgeon may complete an appendectomy in fifteen minutes whereas another may require thirty minutes. It must be recognized that ability to work rapidly is not evenly distributed among surgeons; and although precision training tends to level off this inequality, it can never be entirely overcome. No single time standard can be set for different men, but use of uniform methods will permit each man to complete the work in the shortest time compatible with his talents. Motion too rapid for the capacity of an individual is highly dangerous as it induces hasty and inaccurate work.

2. *Distribute motion in accordance with the inherent capacities of fingers, hands and arms.* The characteristics of arm and hand motion permit classification into four groups:

(1) Finger motion alone with wrist, elbow and shoulder stationary is the most accurate for fine detail, requires the least time and effort and so produces the least fatigue. With prolonged or heavy use, however, fingers tire more quickly than hands and hands more quickly than forearm. Finger motions are used in opening and closing hemostats and in feather edge dissections with a knife.

Training will increase the agility and dexterity of finger movements up to a certain point but this maximum point varies widely in different individuals.

(2) Wrist motion is slower than finger motion and somewhat less accurate but permits a much firmer grasp and can be used against more solid resistance. Wrist motion is usually employed in making a free incision or in suturing with a needle holder.

(3) Forearm motion uses the elbow as a pivot and is slower and stronger. Resultant fatigue varies as the motion is vertical, horizontal, circular or torsional. It is used typically in exploration and in heavy through-and-through suturing with a needle holder.

(4) Shoulder motion is the slowest and least delicate type and is most likely to disturb postural balance. It is best adapted to prolonged heavy work such as traction.

Finger motions are more accurate than those controlled by the forearm, and motions involving the upper arm and shoulder are most suitable when strength is required. (Table 1.)

3. *Use each hand for the purpose for which it is best fitted but do not utilize one hand to the exclusion of the other.* It is necessary to determine whether either hand is overworked or underworked. In industrial processes both arms are used to equalize the load wherever possible. In surgery this can be followed only to a limited extent because of the specialized functions of the right hand. However, it is possible to transfer elemental motions to the left hand so that the work is more equally divided. The work load will then be assigned to left and right hands, not equally from the point of fatigue, but according to the special capacities which each possess.

The left hand should come in for a full share of work and particularly should it be used for the more fatiguing activities. It should not, however, be considered only as a vise with which to hang on to a heavy instrument. Since it is less practiced and therefore less adept, a considerable degree of training is necessary before delicate motions can be undertaken with it. It must be remembered also that locked instruments such as scissors and hemostats are designed for right-handed use and in using them with the left hand a special technic is required. It is inadvisable to attempt to develop true ambidexterity as it offers no marked advantage. In general it may be said that the right hand should be used for incision or dissection with knife and scissors and such other work as requires delicacy of touch. Accordingly, the right hand should be spared such heavy and tiring work as manual lysis of adhesions or work involving continued or excessive strain. If either hand must be tired by hard or protracted muscular strain, it should be the left one. A general rule may be laid down that the right hand is used where precision work is demanded and the left hand for exploration, traction, and transportation of instruments.

4. *Motions should be performed in orderly sequence to permit smooth and automatic technic.* Each phase of work should be carried on so that one step follows another in logical and unvaried succession. As each step is completed the next one should be ready to begin without delay or hesitation. When circumstances demand caution motions must of necessity be slowed down. This should be distinguished from hesitation which, when often repeated, should be investigated as to its cause. It may be due to some special characteristic of the surgeon, to faulty choice of tools or to the method of approach.

Observation of a large number of practicing surgeons indicates a prevalent use of non-essential motions due to failure to carry on a continuous line of motion. One such study showed a total of fifty-five unnecessary motions in a five-minute period by a surgeon and his assistant. A common failing when dealing with a bilateral lesion is repeated shifting of the point of attack from side to side. Careful inspection and planning would reduce the number of such shifts without increased risk or loss of efficiency. Each proposed change must be analyzed in the light of past experience and with an unprejudiced mind. It is not proposed to regiment technic but to eliminate steps based solely on preformed individual habits.

5. *Free swinging motions are faster, easier and less tiring than restricted or controlled motions.* This applies chiefly to the making of incisions. Surgical incisions vary widely but should always be planned to provide adequate exposure of the field. A rule of proved value is that an incision should be as long as is required by the individual operator and no longer.

A free swinging motion results from the use of a muscle group with no antagonist group opposing it. Such motion is seen in the swing of a golf club or tennis racket. Most primary incisions should be of this type and should be made with a continuous single sweep through the skin and subcutaneous tissue at exact right angles to the skin surface. It must be made with detailed knowledge of underlying structures and an appreciation of tissue resist-

ance. Unless meticulously accurate, it may be very dangerous. A long incision which does not penetrate all layers of the skin or a series of short hacking cuts marks the operator as inexperienced, fearful, or uncertain of his landmarks. Contrariwise, an overbold slashing incision is hazardous. An incision penetrating the skin obliquely makes for poor approximation and faulty wound healing.

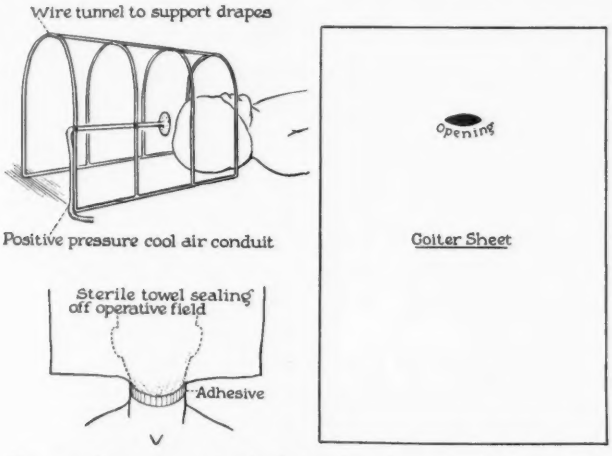

Fig. 3. Former method of draping for thyroidectomy included (1) wire tunnel to support drapes, (2) cool air device for use with local anesthesia; (3) sterile towel fastened with adhesive below the chin and thrown upward across distal end of wire frame, (4) laparotomy sheet with acentric opening. This arrangement was effective but complicated.

Controlled or fixation movements produced by antagonistic muscle actions are slower and more tiring than those which work against no antagonists. Such motions come into play in threading a needle. They are delicate and precise and should be used when working in the vicinity of blood vessels or other important structures. Constrained motions, where muscles must be held rigid for guidance, should be entirely eliminated.

6. *Use the fewest motions which will do the work in the best way*. A continuous line of motion in acquiring and disposing of instruments is preferable to a series of interrupted motions since the single sweep is quicker and more certain. Similarly a continuous arc motion is easier and quicker than a straight line motion which involves sudden and sharp changes in direction. The work should be so arranged that the paths described are smooth and continuous whenever possible. However, where such a continuous motion necessitates twisting the body or crossing the arms beyond the normal range, the advantage of a single motion is nullified. In that circumstance instruments should be transferred from hand to hand. Thus, an instrument far out in the left arc area should be picked up with the left hand and transferred to the right for use.

In operative procedure, too, superfluous motions can be omitted. A thyroidectomy collar incision may require repeated ligations of the same vessel at different levels if the primary incision fails to carry through all layers and the flaps are not properly delineated before ligation of vessels is begun.

In these times of shortages it is well to check up on the use of essential materials such as linens, sponges and suture materials. Preoperative skin preparation can be made uniform for an entire service as can be the method of draping the field. The function of draping is to maintain a sterile surface and any additional use of sterile linens is pure waste. The method of draping is less important than that the

same method be used by an entire service. (Figs. 3 and 4.)

Materials such as sponges, pads and

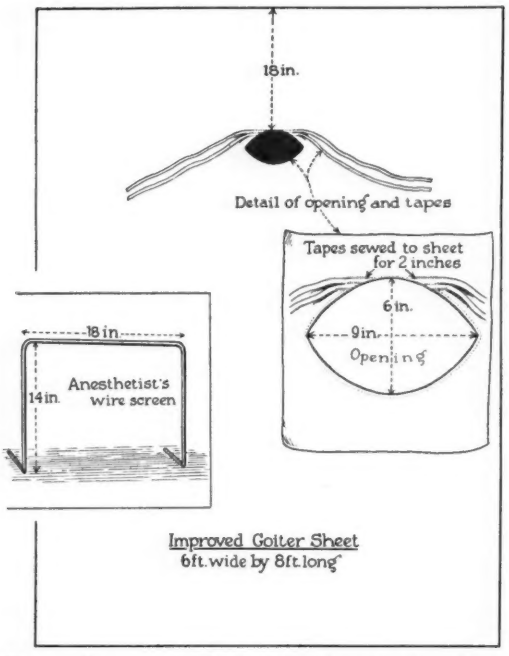

Fig. 4. Present method of draping for thyroidectomy; modified laparotomy sheet with tapes sewed to upper level of elliptical opening. These tapes are tied behind the neck. Two pairs of tapes are more satisfactory than one.

sutures should be reduced to the smallest variety that will adequately serve the purpose. It is amazing what a survey will reveal in the way of unnecessarily varied dressings. Simpler or cheaper substitutes are often equally useful. It is perfectly feasible to use only large strip dressings fastened with tape and metal ring in any operation in which a cavity of the body is opened. Loose and stick sponges are not needed in such operations, as practice with strip sponges make their use entirely satisfactory and reduces the work and nerve strain incident to making small sponge counts.

Every operating room supervisor can testify to the amount of wasted catgut remaining after an operation. Most of this waste follows its use in ligation.

Ligatures may be limited to four types: (1) Two-handed square knot with free ends; (2) two-handed square knot with needle attached; (3) one-handed square knot, and (4) pedicle knot for mass ligation. A one-handed free tie uses roughly twice as much material as a two-handed tie. Continuous sutures use less material than do interrupted sutures but offer other disadvantages. Continuous catgut sutures should not be used when non-absorbable material is used in the same wound. They offer less security in the presence of wound infection and impose the risk of spontaneous untying of a knot which might release the entire suture layer. Economy of suture material, however desirable, must remain secondary to the safety factor. Figure-of-eight non-absorbable retention sutures may be placed so that a small coaptation loop includes only the edges of the fascia and the free ends include all layers from skin down to muscle. These provide good wound support, obliterate dead space and reduce the number of interrupted fascial sutures by one-half.

Gilbreth noted in his early studies that each craftsman, left to his own devices, used his own particular method in doing his work and no two men did their work in exactly the same way. It is advisable in addition to standardize motion procedure so that a fixed type of operation can be used in every case in which variations from predetermined technic is not indicated. Failure to adopt and carry out a repetitive technic in any one kind of operation may mean that no outstanding method has been developed or may indicate lack of thorough organization of a surgical group.

Repetitive processes properly carried out soon become automatic. A recent report on changes necessitated by a shortage of male workers in a technical industrial plant shows that where men are replaced by women precision work is done better and with more dexterity, provided that they are so placed that all tools are within reach and that the women do not have to leave fixed positions. If they are obliged to move about to complete the process, their efficiency falls rapidly to a level below that of the men. In the latter cir-

cumstance the benefits of automatic action are lost.

Fixed types of operation can be applied to large groups of cases. These should be specified and carried out uniformly by the entire surgical service and variations or additions should be considered and discussed by the group before being introduced by an individual member. This permits deliberate and reasoned consideration of new ideas, without hasty acceptance of untested changes. It is notable that a young intern's enthusiasm for each suggested change in technic contrasts vividly with the older surgeon's reluctance to leave the channels into which experience has grooved his thinking.

Some institutions and organizations have adopted standardized forms of operative procedure with marked improvement in end result. Care must be taken to avoid overdoing limitation in the choice of method, so as not to try to include cases in which variations of technic would actually be of benefit. When, however, an individual operator finds it necessary to change the accepted standard operation in more than the average percentage of cases, as determined statistically, he should be suspected of unnecessary individualism.

A scientific fact finding survey is a necessary preliminary to the institution of changes in an existing system. First, the present situation in the operating room should be analyzed and recorded. The physical set-up should be surveyed with a view to addition, elimination or rearrangement of equipment, based solely on actual requirements. The need is for the right tools located where they can do the most efficient work with the least effort. The arrangement must provide for ready acquisition, use and disposal of instruments.

1. Are the general working conditions as good as possible?

2. Is there any unnecessary moving about or back-tracking by the operating room assistants?

3. Are the instruments located and arranged to the best advantage?

4. Is provision made for the maintenance of a clean and orderly table throughout the operation?

5. Is provision made for the safe disposal and accurate accounting of needles, sponges and materials which might be left in the body?

6. Is a uniformly repetitive technic followed as far as possible?

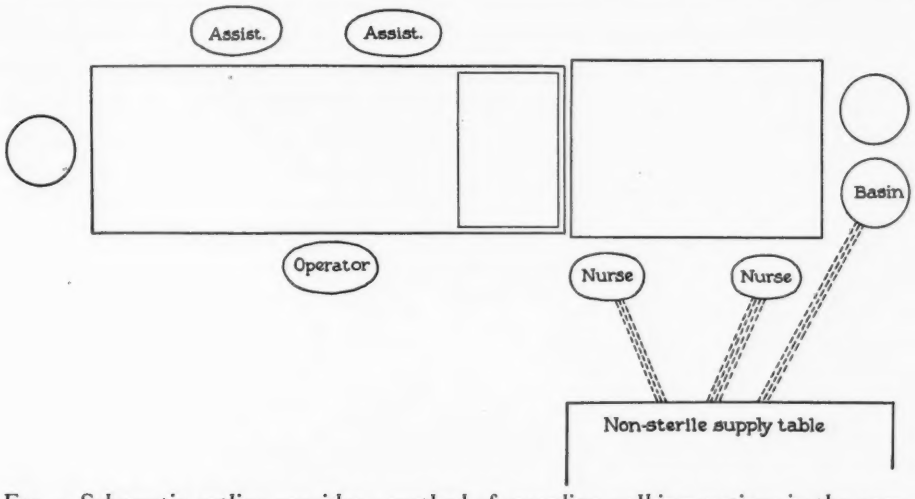

FIG. 5. Schematic outline provides a method of recording walking motions in the operating room. Each trip is marked with a dotted line indicating the path taken. Under perfect conditions there should be no marks on the chart from the time of incision until closure is completed. A separate chart should record walking motions during the period of surgical preparation. Walking paths of non-sterile personnel are best indicated in color.

7. Are motion processes smooth and continuous and in proper order?

8. Can any motions be eliminated or combined?

9. Is either hand overworked or underworked?

10. Is work properly distributed between operator and assistant?

11. Is every precaution taken to prevent fatigue?

12. Can any step be harmonized with an equally effective method used by other members of the service?

Next, consider elements of silence and orderliness. Avoid clutter by getting rid of unneeded equipment. A disorderly workplace is only too often associated with unclear thinking.

Then review existing methods of motion procedure, seeking to refine current practice, correct improperly performed functions, combine duplications, eliminate unnecessary steps and avoid unwarranted variations. Consider each step as to its necessity and desirability and subject every process to critical inspection to determine whether a good method can be replaced by a better one. (Fig. 5.)

After this weigh the human element. Decide whether the members of an operating team are working as a unit and whether the motions of individuals are carried out in proper sequence.

To justify change there must be an improved result or a result equally good with a saving of time, effort or cost. In evaluating a change immediate result must be distinguished from long range result. Installation of an improved and more effective method may actually slow down the process until sufficient time has elapsed for new methods to become automatic.

It is essential not only to find the most effective methods but to train others with sufficient thoroughness to carry on the work. Training may begin with such elementals as tying of knots, insertion of sutures and handling of instruments. A simple way to increase the agility of the left hand is to have beginners use the left hand in brushing their teeth and hair.

Hospital records indicate that the most commonly performed operations are, in order, appendectomy, repair of hernia, thyroidectomy and cholecystectomy. Appendectomy can, in a great majority of cases, be carried out under predetermined standardized technic thus becoming a repetitive process which may readily be used for the training of a new operating team or re-education of existing personnel.

A standard method of skin preparation, positioning and draping should be adopted. Distribution of duties between operator and assistants should be defined and assistants taught to use each hand to best advantage and to distribute the work load between the hands. Much can be accomplished even with rapidly changing personnel in reducing time and effort in routine surgical procedure.

The day of the natural born surgeon passed long ago and the recent years of transition have resulted in the development of three types of surgeons: old timers who learned by clinical experience sometimes supplemented by a post-graduate course abroad; the modern scientifically trained man who followed a progressive course through internship, residency, and university teaching hospital affiliation; and a group between the two who had modern medical training but, because of lack of opportunity for residencies and teaching affiliations, continued their work in self-education and development through clinical practice and study. Competence may be found in each of the three groups but it is safe to forecast that surgeons of the future will come almost exclusively from the second group. It behooves us, therefore, to train with utmost caution and infinite care the young medical graduates who come under our supervision in the plastic stage of development. Proper training should begin the first day a young intern begins his training in operative surgery, and it is important that they not be

permitted to practice methods which must later be unlearned.

CONCLUSIONS

This study is concerned less with time than with motion simplification, with process rather than product control. It seeks to provide uniform, standardized equipment, placed in proper sequence within normal reaching range and in fixed and unvaried position.

Motion processes should be correctly distributed between operator and assistant and the work load divided between the right and left hands according to the special capacities of each. Motions should be smooth, continuous and decisive and as nearly automatic as possible.

Delay and fatigue factors should be identified and reduced or eliminated.

In revising current methods it is desirable to make the fewest possible changes in equipment, to use the smallest number of specialized instruments and to avoid frequent and radical changes in design or method.

Equipment and instruments already owned should be used as far as possible and in such a way as to effect the desired result by the most direct and simplest means.

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A NEW TECHNIC FOR INSTILLING AMNIOTIC FLUID CONCENTRATE INTRA-ABDOMINALLY AT THE CLOSE OF OPERATIONS

TWENTY-SEVEN CASE REPORTS

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ONE of the chief functions of amniotic fluid in its natural location is to prevent adhesions between the amniotic sac and the fetus. In 1927, Johnson[1] offered the opinion that amniotic fluid is the logical substance to prevent peritoneal adhesions following abdominal operations. The instillation of this fluid into the abdomen was suggested to Johnson following a cesarean operation in which amniotic fluid from the uterus had been permitted to spill over into the abdomen. The postoperative results in this case were unexpectedly satisfactory and consequently experiments[2] were undertaken in which concentrated bovine amniotic fluid was introduced into the peritoneal cavities of guineapigs, after the peritoneum had been traumatized. Control pigs which had not been treated with amniotic fluid developed many more peritoneal adhesions than the treated animals. Thereafter, concentrated bovine amniotic fluid was employed clinically in a number of cases.[3] The conclusions arrived at were that amniotic fluid may be used with safety in the animal or human peritoneal cavity, that it reduces the number and extent of adhesions formed, and that it does not interfere with normal healing. It was assumed that the fluid acts by reducing the amount of oozing from injured surfaces, thereby lessening the quantity of fibrin formed, and that, in all probability, it lubricates the peritoneum until the danger of adhesions has passed.

Trusler[4] subjected the peritoneum of dogs to trauma and bacterial contamination, and observed that there occurred a lower death rate in animals treated with amniotic fluid concentrate than in untreated controls. He arrived at the conclusion that amniotic fluid stimulates the normal processes of repair and thus minimizes postoperative adhesions. On the other hand, amniotic fluid concentrate is unable to digest or dissolve adhesions already formed, or to impede in any way the normal "walling off" of inflammatory areas in the peritoneum. Patients subjected to various types of abdominal operations tended to enjoy a smooth postoperative course when amniotic fluid had been used.

At a later date, Kimpton[5] reported that he had used amniotic fluid concentrate in 400 major operations. He described one particularly interesting case: The first operation on this patient had been cholecystectomy with lysis of adhesions; but dense adhesions had formed again, causing pyloric obstruction and making another operation necessary. Several subsequent operations for lysis of adhesions had followed and during the last one of these, amniotic fluid concentrate was injected into the peritoneal cavity. The immediate and remote postoperative results of this final operation were highly satisfactory. Sixteen months later the patient showed "no symptoms that would even remotely suggest the re-formation of adhesions."

My own experience with amniotic fluid concentrate began in 1931, when I used it in an operation for ventral hernia. It is my desire to describe here in chronological order twenty-seven abdominal operations performed between 1931 and 1940, in which amniotic fluid concentrate was used. I will also attempt to trace the gradual

development of instruments and a more efficient technic for the introduction of amniotic fluid* concentrate into the abdomen.

CASE REPORTS

Case I. On October 26, 1931, a female, age forty-four, had a herniotomy and lipectomy performed. An appendectomy in 1928 had been the cause of a ventral hernia, and in 1931 repair was attempted. At the close of the operation, about 200 cc. of amniotic fluid concentrate were poured through a funnel and catheter into the peritoneal cavity, but some of it spilled out on the wound surface through lacerations in the peritoneum and fascia. Serous drainage of the wound for several days following operation resulted, but the patient left the hospital improved. Subsequently, she underwent treatment for tabes dorsalis.

Case II. On August 20, 1932, a female, age thirty-two, had a supravaginal hysterectomy and removal of postoperative adhesions performed; 200 cc. of amniotic fluid concentrate were instilled by funnel and catheter. Here, as in Case I, the consequences of a previous operation did not allow a complete subperitoneal distribution of the fluid, and a certain amount of it came in contact with the surface to be sutured for closure. Considerable postoperative serous drainage was observed, in spite of the fact that all tissue which had been in contact with amniotic fluid concentrate had been removed surgically; but the patient did not complain of abdominal discomfort. She is in good health today.

Case III. On August 29, 1932, a female, age thirty-seven, underwent a right oophorectomy, salpingectomy, and supravaginal hysterectomy with severing of many intestinal adhesions; 400 cc. of amniotic fluid concentrate were instilled by funnel and catheter; but, in spite of careful closure, serous drainage from the bottom of the wound continued for a considerable length of time after the patient had left the hospital. There have been no postoperative abdominal complaints.

Case IV. On September 29, 1932, a female, age twenty-one, had adhesions on the right edge of the omentum, the site of a previous appendectomy, removed. A band of omentum, reaching to the right Fallopian tube and horn of the uterus, closed the ileocecal junction; 400 cc. of amniotic fluid concentrate were instilled by funnel and catheter, and, due to the redundant peritoneum, the entire quantity entered the abdomen without any of it being lost. There followed speedy healing per primam and a short period of convalescence. She is in good health today.

Case V. On October 6, 1932, a female, age forty-eight, had a Doyen panhysterectomy performed. The significant past history of this patient was that she had been delivered of six children at home on a farm, and without adequate medical care. The symptoms she presented were: bleeding from the vagina, badly inflamed cervix, weakness, anemia and foul-smelling vaginal discharge. Preoperative treatment included three days of continuous vaginal irrigation with a Gray reflow irrigating speculum, using a 1:2000 titanium iodide solution with a Baxter jar as container. At operation cystic ovaries, enlarged fibrous uterus, and bleeding polypi uteri were found. The cervix was enlarged, with enlarged irregular and ulcerated lips. After panhysterectomy, 400 cc. of amniotic fluid concentrate were instilled. Because of redundant peritoneum the entire quantity was easily introduced subperitoneally by the catheter-and-funnel method. Recovery was uneventful. The choice of amniotic fluid concentrate with primary closure was considered preferable to vaginal drainage, a decision justified by the results. The patient is well to date.

Case VI. On April 14, 1934, a female, age fifty-four, presented partial intestinal obstruction, massive abdominal adhesions and a ventral hernia. The patient had undergone an operation for gangrenous appendicitis twenty-eight years previously. There were adhesions between many abdominal organs, namely, liver, stomach, small intestine, colon, uterus and adnexia. Following operation, which included separation of tough adhesive bands, 400 cc. of amniotic fluid concentrate were instilled. (But this procedure was not accomplished as easily and successfully as desired, and it became apparent that a new technic for the instillation of amniotic fluid concentrate was required.) The patient responded well and improved. Her death after three years was due to cardiac decompensation and had no connection with this operation.

Case VII. On April 24, 1934, a female, age thirty-four, had a right oophorectomy, supra-

* The amniotic fluid concentrate used in all of these cases was "Amfetin" (Amniotic Fluid Concentrate, Lilly).

vaginal hysterectomy (endometriosis), removal of adhesions and lipectomy performed. Previous operations had been: appendectomy and removal of tumor of left ovary with both tubes in 1920, followed by bilateral inguinal herniotomy in 1932. An attempt to instill 400 cc. of amniotic fluid concentrate intra-abdominally, by means of catheter and funnel, did not succeed. After approximately one ounce had been introduced in this manner, it became obvious that the fluid escaped into adjacent muscle and fat tissues. Therefore, the remaining 370 cc. had to be instilled by means of a 50 cc. syringe with a No. 19 gauge needle inserted into the right lateral side of the abdomen. In this instance, positive pressure was substituted for gravity, in order to force a sufficient amount of amniotic fluid concentrate into the peritoneal cavity. The patient recovered rapidly in spite of some serous drainage, and suffered no more abdominal complaints. In 1938, she was confined to a sanatarium because of mental deterioration, where she died of chronic alcoholism of long standing.

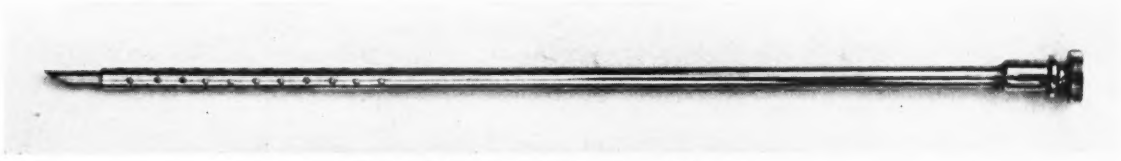

Fig. 1. Photograph of trocar with stylet.

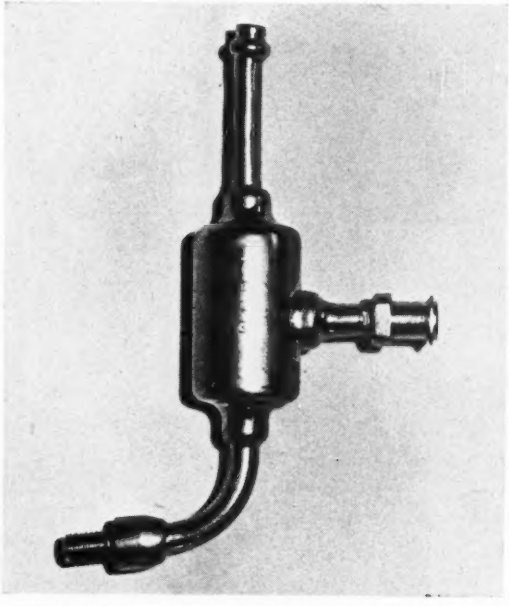

Fig. 2. Photograph of two-way valve.

Case viii. On November 5, 1935, a male, age thirty-nine, presented a case of chronic appendicitis with adhesions. In this case, only 200 cc. of amniotic fluid concentrate could be instilled via funnel and catheter, and it was necessary to discard about 100 cc. of the fluid. The patient improved steadily. Freed from toxic symptoms including a disabling sciatica, he has since been able to practice his profession profitably. At present he is under treatment for a Giardia infection.

The foregoing experiences with the funnel-and-catheter method led to the conclusion that a special instrument for the introduction of amniotic fluid concentrate into the peritoneal cavity was required. A dull-edged trocar was designed and made (Fig. 1), about 24.4 cm. in length and approximately 0.5 cm. in diameter. A stylet with a relatively dull edge was made to fit the bore of the trocar. A series of small openings, arranged in four columns, extend from the distal end up the shaft of the trocar, about 7.5 cm. The length of the trocar allows the surgeon to project the distal end beyond the midline by means of a small abdominal incision. By directing the trocar toward the opposite pelvic rim, he avoids any undue pressure upon the incision line while the fluid is being administered. (Fig. 1.)

The proximal end of the trocar is covered with threads which are the recipients of threads on a two-way valve. (Fig. 2.) Thus, the trocar and two-way valve can be joined securely together.

To one of the remaining two openings of the two-way valve is fixed an arrangement permitting the use of a 100 cc. syringe (Luer-Lok preferred), while the remaining opening is attached to the end of a small-caliber rubber tubing, which by means of a glass adapter tube is connected to a

rubber tube of sufficiently large caliber to fit over the end of the Kelly jar. This system permits the sucking of amniotic fluid concentrate from the Kelly jar into the valve, thence into the syringe. By positive pressure the amniotic fluid concentrate is then instilled into the abdomen at will. (Fig. 3.)

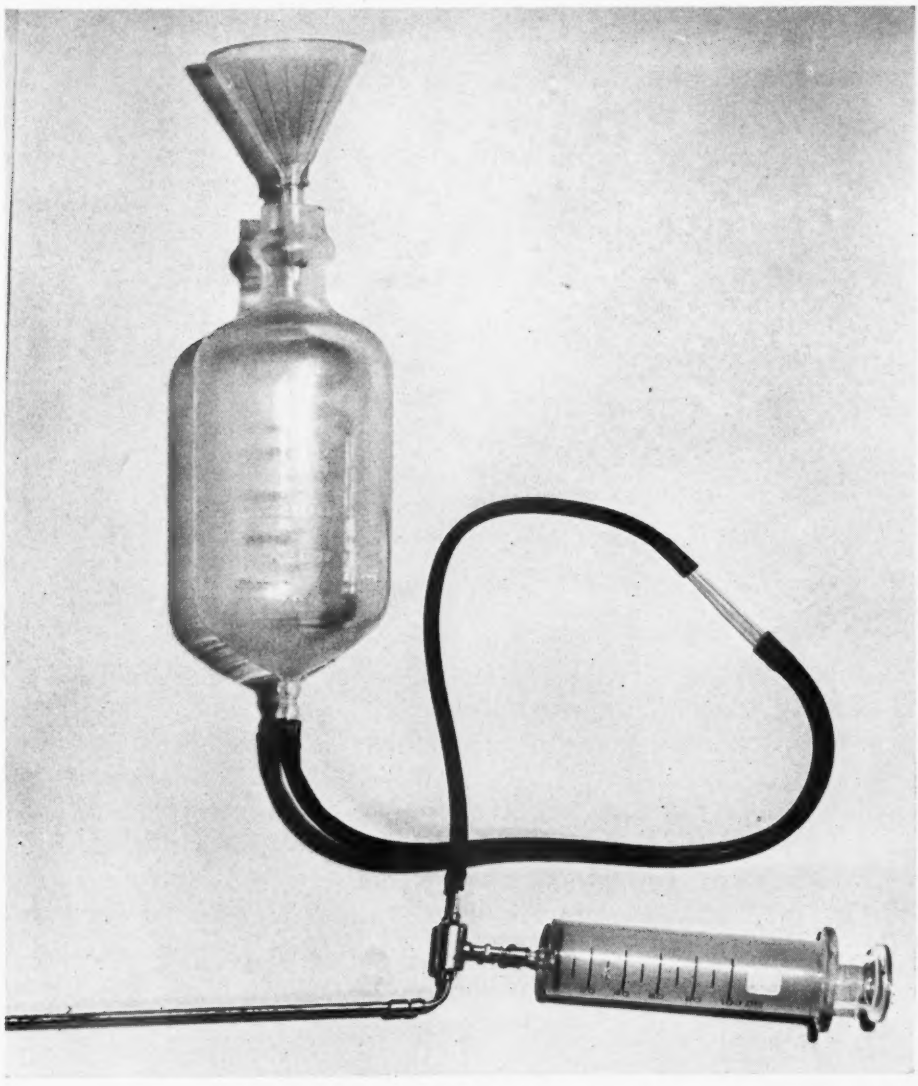

FIG. 3. Photograph of complete apparatus.

In this manner the maximal amount of amniotic fluid concentrate may be instilled into the peritoneal cavity. At the same time, the process can be stopped immediately at the point where further instillation would lead to spilling of the fluid outside of the peritoneum.

It may be said that the careless handling of tissues, and especially insufficient care at closure of the abdominal wound is a common cause of adhesions, frequently forcing the patient to seek surgical relief through a subsequent operation. Amniotic fluid concentrate, properly administered, plus a systematic method of closure seems to offer a satisfactory means of overcoming these difficulties.

In all cases, unless otherwise indicated, the incision was kept in or near the midline. Thus the cutting of muscles is avoided. The cutting of fascia is preferable to the cutting of muscles by reason of the better healing qualities of fascia. The closure was made according to the teachings of Edward H. Ochsner, who maintains that the peri-

toneum should be closed from both ends of the wound toward the middle of the longitudinal incision axis. By this method a better closure can be expected, and injury to the bowel or other abdominal tissue in the final process of closing the abdominal cavity becomes unlikely. It also decreases the danger of the end of the suture pulling out, causing a hernia.

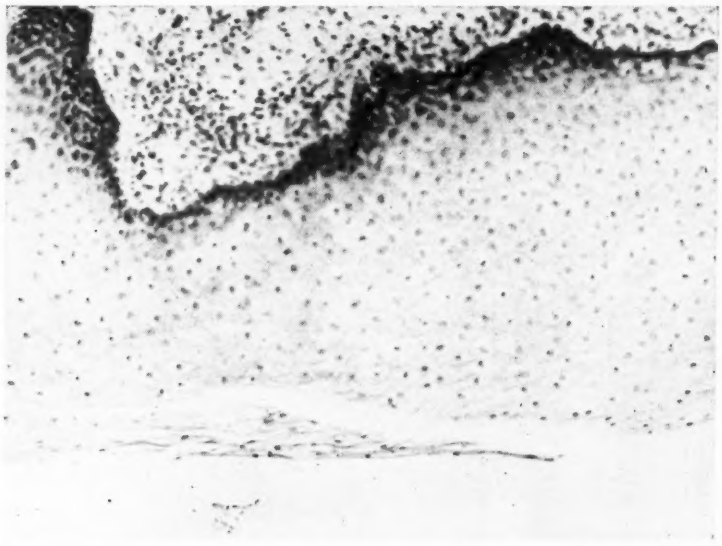

FIG. 4. Case v. Photograph of squamous epithelium of cervix uteri.

Using double No. 1 plain catgut, the peritoneum is sutured from both ends toward the middle, until the operator is able to insert no more than two fingers of the left hand, which function as a guide from within, against the lateral wall of the lower part of the abdomen. With the right hand a sharp scalpel is used to make a small hole through the abdominal wall and barely through the peritoneum. Then, still keeping the fingers of the left hand in place, the dull-edged trocar with its dull stylet is inserted into the abdomen through the small wound. As soon as the trocar enters the abdominal cavity, the stylet is immediately withdrawn and a sterile towel placed over the exposed end of the trocar. The distal end, being dull and having no undue pressure exerted upon it, rests freely and harmlessly in the abdomen. The peritoneum is then closed. The several tension sutures used, serve: (1) in order to relieve the strain on the longitudinal suture line, and (2) to lessen the accumulation of exudate, blood, etc., in pockets between fascia and muscles.

The fascia sheaths or fascia are then closed by double No. 1 chromic catgut. Sometimes a few interrupted plain sutures are placed loosely in the muscle following which a warm sponge is placed in the wound. Next, one part of the two-way valve (described previously) is attached (1) to the outer end of the trocar, (2) the second one to a 100 cc. syringe, and (3) the third outlet is fastened to the rubber tubing from the Kelly jar. The amniotic fluid concentrate is then instilled into the peritoneal cavity as desired. As soon as this is accomplished, the trocar is removed and the small wound through which it was inserted is sutured. Six strands of silkworm gut sutures are placed at the bottom of the wound with their distal ends projecting below the end of the skin wound to act, for a few days, as a subcutaneous drain. The skin is closed with sutures or clips.

In the case reports which follow, the method just described has been used for the administration of 200 to 800 cc. of amniotic fluid concentrate.

CASE IX. On December 6, 1935, a female, age thirty-nine, underwent an appendectomy, right salpingo-oophorectomy and removal of adhesions. This patient had suffered a Neis-

serian infection eighteen years previously. Amniotic fluid concentrate, 200 cc., was successfully instilled by means of the trocar. The

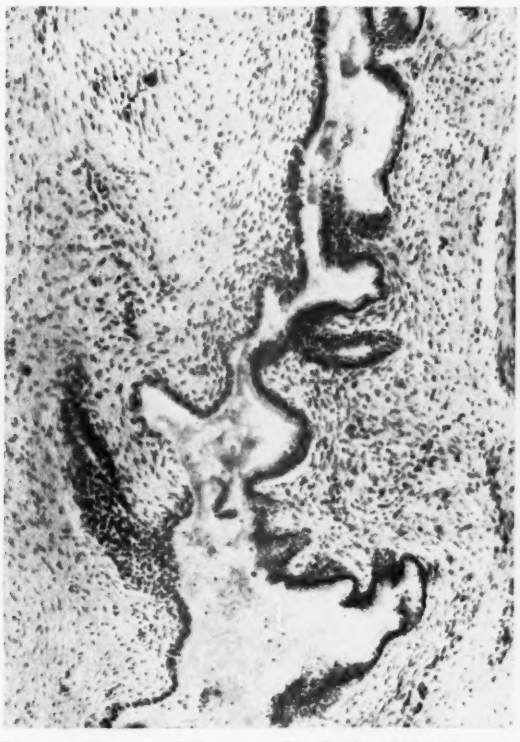

Fig. 5. Case v. Photograph of glandular hypertrophy of cervix uteri.

wound healed per primam. The patient recovered steadily and has remained in good health.

Case x. On May 12, 1936, a female, age fifty-six, had a panhysterectomy performed. The patient complained of a tired feeling and of bleeding at irregular intervals, for three months. A foul vaginal discharge was present and an ulcer was found on the posterior cervical lip of the uterus. Radium treatment was refused by patient and family. For three days previous to operation a daily vaginal irrigation was carried out with titanium iodide solution 1:2000 through a Gray reflow vaginal speculum and Baxter type jar container. After panhysterectomy, 400 cc. of amniotic fluid concentrate were easily instilled by trocar. The cervix lesion was a squamous cell epithelioma. The patient improved after surgery and returned home maintaining the improvement for some time. Death due to carcinoma of the intestines occurred ten months after operation.

Case xi. On July 16, 1937, a female, age twenty-one, underwent an appendectomy and removal of adhesions. Amniotic fluid concentrate, 200 cc., was easily introduced by trocar. Healing occurred per primam. There have been

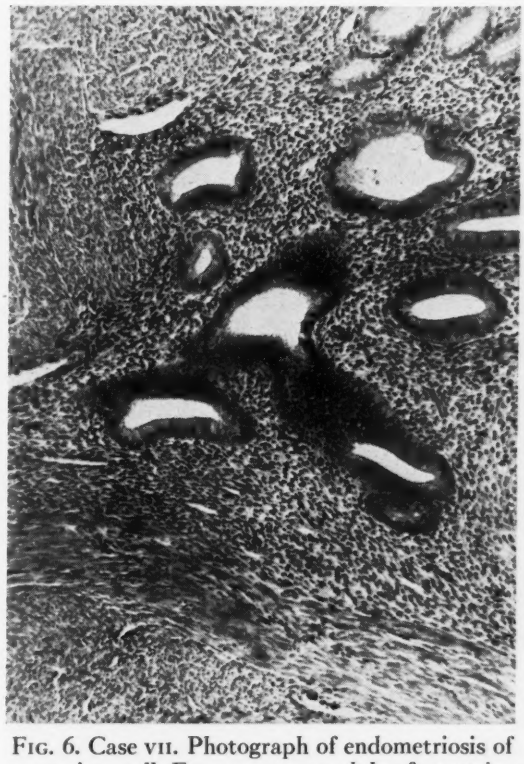

Fig. 6. Case vii. Photograph of endometriosis of uterine wall. From a 2 cm. nodule of posterior wall of uterus 4 by 4 cm. (Measurements of pathologist, Dr. J. W. Budd.)

no abdominal complaints to date. The only medical attention sought since operation was for the uneventful normal delivery of a baby.

Case xii. On August 6, 1937, a female, age twenty-six, had a left salpingo-oophorectomy performed. The patient had undergone appendectomy five years previously. A left parovarian cyst and salpingitis were found, complicated by adhesions from the previous operation. Amniotic fluid concentrate, 200 cc., was introduced by trocar. The patient made a rapid recovery and is at present in a good state of health.

Case xiii. On September 9, 1937, a female, age thirty-eight, underwent an appendectomy, removal of adhesions and freeing of a Jackson membrane. The adhesions appeared to be the result of some previous peritoneal inflammation. Amniotic fluid concentrate, 200 cc., was instilled via trocar. The patient improved, except for a Staphylococcus albus infection at the lower end of wound. This responded to

treatment with a Staphylococcus albus lysate. She is in good health at present.

Case xiv. On December 1, 1937, a female, age twenty-seven, underwent an appendectomy, right salpingo-oophorectomy and removal of adhesions. Amniotic fluid concentrate, 400 cc., via trocar was instilled. She had an uneventful recovery and is now in a good state of health.

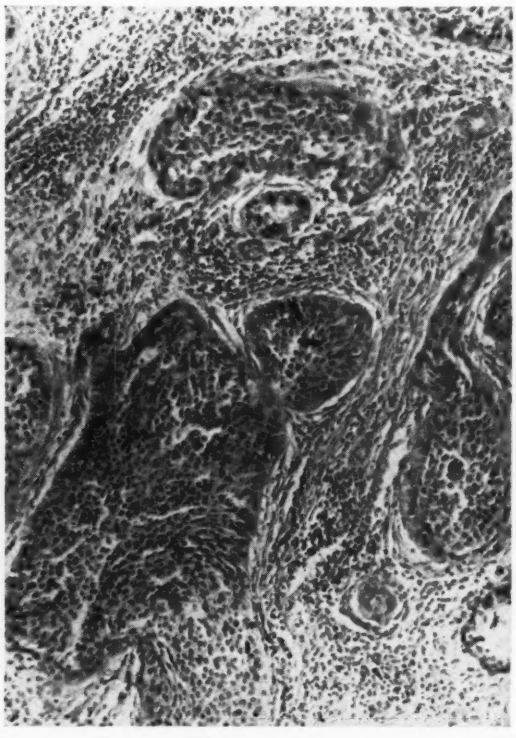

Fig. 7. Case x. Photograph of squamous cell carcinoma of cervix uteri. Grade iii. (Opinion of pathologist, Dr. Maner.)

Case xv. On December 31, 1937, a female, age fifty-two, underwent a cholecystectomy and removal of adhesions. This patient's past surgery included: appendectomy in 1907, left breast removed in 1932, right breast removed in 1936 (Schimmelbusch's disease). Amniotic fluid concentrate, 600 cc., was instilled via trocar, and the wound closed without drainage. The patient recovered and is in good condition today. However, because of the possibility of accessory biliary sinuses, etc., Walters'[6] advice that a drain should be employed as a matter of routine for about seven days, appears to be highly justified.

Case xvi. On April 21, 1938, a female, age thirty-four. Bilateral oophorectomy, appendectomy and removal of bilateral peritoneal adhesions were performed. Amniotic fluid concentrate, 600 cc., was instilled by trocar. The wound healed per primam and recovery was uneventful and rapid. The patient's health is good to date.

Case xvii. On June 29, 1938, a female, age fifty-six, was operated upon for appendicitis and removal of right tube and ovarian cyst. Amniotic fluid concentrate, 400 cc. was introduced by trocar. The wound healed per primam and her condition is much improved. She is successfully carrying on her profession.

Case xviii. On July 28, 1938, a female, age twenty-four, had an appendectomy performed. Amniotic fluid concentrate, 200 cc. was instilled by trocar. The wound healed per primam and she had an uneventful recovery. The patient is in a good state of health to date.

Case xix. On March 30, 1940, a female, age fifty, had an appendectomy performed and freeing of many dense adhesions from a previous pelvic peritonitis; 400 cc. of amniotic fluid concentrate were instilled via trocar. The patient had a nutritional deficiency of long standing, resulting from neurosis. On the tenth day the patient suffered an evisceration, and a second operation had to be performed on April 9, 1940. A Judd type catheter was inserted in the ileum; this was accidentally pulled out of the intestine, while a nurse was arranging the gauze dressing. A Miller-Abbott tube was introduced. Blood transfusions were given April 10th, 15th and 26th. In view of the deficient healing of the tissue, large doses of vitamin c and the best available b complex compounds, calcium, parathyroid extract, etc., were administered. The use of the Miller-Abbott tube was followed by a parotitis on the right side. The infecting organism proved to be Staphylococcus aureus. The parotitis responded favorably to treatment with Staphylococcus aureus lysate. In spite of the trauma and fecal contamination, incident to the evisceration and its repair, the patient did not develop peritonitis and its lethal sequelae. It may safely be assumed that absence of peritonitis in this case can be attributed to the use of amniotic fluid concentrate at the time of the first operation. The abdominal wound healed well and the patient was released from the hospital in good condition. She improved steadily upon a strictly supervised diet, etc. Her health at present is good.

Case xx. On April 4, 1940, a female, age thirty-four, had an appendectomy performed

and freeing of adhesions. Amniotic fluid concentrate, 800 cc. was instilled via trocar. The wound healed promptly and the patient improved rapidly. Her health is very good at present.

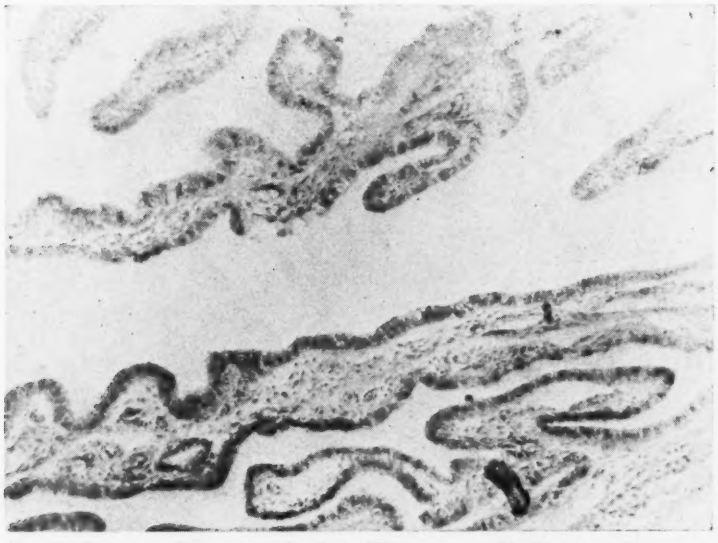

Fig. 8. Case xii. Photograph of papilloma on wall of parovarian cyst.

Case xxi. On May 1, 1940, a female, age thirty-two, had a right salpingectomy and removal of the right parovarian cyst performed. Amniotic fluid concentrate, 800 cc., was installed via trocar. The wound healed per primam and the patient's condition is good today, except for moderate obesity.

Case xxii. On May 23, 1940, a female, age twenty-seven, suffered from bilateral salpingitis, pelvic peritonitis with serosanguineous exudate, visceroptosis, chronic appendicitis, enlarged liver and subacute ileitis. The latter was apparent from preoperative *x*-ray examination. Appendectomy was performed and amniotic fluid concentrate, 600 cc., administered intra-abdominally, in view of the peritonitis. The wound healed per primam. The patient was kept in bed for a short time postoperatively and given a smooth diet, high in vitamins and calories. She was later referred to Dr. Jellen for a postoperative *x*-ray film series, and his reports as well as others to date give no indication of abnormality. Amniotic fluid concentrate as a treatment for peritonitis appears to have been of great value in this case.

Case xxiii. On June 19, 1940, a female, age thirty-two, had an appendectomy and removal of adhesions performed. Amniotic fluid concentrate, 800 cc., was instilled by trocar. She had a rapid uneventful recovery. The wound healed promptly per primam. The patient is active and in excellent health to date.

Case xxiv. On July 5, 1940, a female, age forty-four, suffered from chronic alcoholism which had caused a definite nutritional deficiency. Appendectomy and freeing of adhesions were performed. Amniotic fluid concentrate, 800 cc., was instilled by trocar. The patient made a rapid, uneventful convalescence. Postoperative liver function test showed vast improvement over that taken preoperatively. Her general health improved, except for moderate obesity.

Case xxv. On July 16, 1940, a female, age fifty, underwent the removal of an enormous hydrosalpinx wedged deeply into the pelvis, with dense adhesions, between all possible adjacent tissues. Previously, in Chicago, the patient had been given *x*-ray treatment for an abdominal tumor. Amniotic fluid concentrate, 800 cc., was instilled by trocar. A subcutaneous infection developed at the lower end of wound, but the inflammation responded promptly to Staphylococcus aureus lysate. The patient recovered promptly and was restored to full health on the twenty-seventh day after operation. In view of the widespread trauma suffered by pelvic and abdominal tissues, this result was particularly pleasing. She is in excellent health to date.

Case xxvi. On July 17, 1940, a female, age thirty-nine, underwent a right salpingectomy, oophorectomy, removal of adhesions and appendectomy. Amniotic fluid concentrate, 800 cc., was instilled via trocar. The patient

recovered promptly and was in a very good state of health a few weeks later. A great amount of trauma was caused to the pelvic and abdominal tissues, and it stands to reason that amniotic fluid concentrate must have been of great value, in view of the favorable response of the patient. She is in very good health to date.

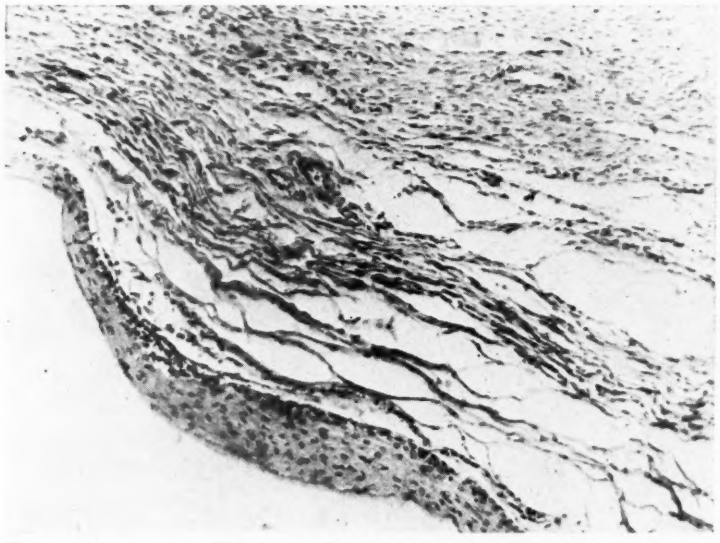

FIG. 9. Case XXVII. Photograph of squamous cell lining of ovarian dermoid cyst.

CASE XXVII. On July 26, 1940, a female, age twenty-seven, had a right oophorectomy (*dermoid cyst*) and appendectomy performed. Amniotic fluid concentrate, 800 cc., was instilled via trocar. She had a rapid recovery and is in excellent physical condition to date.

COMMENTS

A comparison of the results of the first eight cases with those of Cases IX to XXVII indicates that instillation of amniotic fluid concentrate by means of the trocar plus positive pressure is definitely superior to the funnel method previously used. Peritoneal sacs vary as much as the faces of different individuals. One patient may have a well developed, thick peritoneum, and then again the peritoneum may be so small that there remains little space between intestine and peritoneal wall sac. In one case, positive pressure may be necessary in order to instill enough amniotic fluid concentrate. In another, as for example in Case IV, there may be a sufficiently redundant peritoneum, so that adequate amniotic fluid concentrate instillation is easily accomplished by gravity alone. But only a method of instilling amniotic fluid concentrate, which will succeed adequately under *all* conditions can be considered as entirely satisfactory. The trocar method exerting positive pressure fulfills this requirement.

Different substances have been used to assist the defense mechanism of the peritoneal cavity, in resisting the ravages of infection and the consequences of trauma. But it seems that amniotic fluid concentrate accomplishes that function best. From the point of view of physiology, the use of amniotic fluid concentrate can readily be justified. In all cases described here, it has been instilled postoperatively. There is no desire to detract from the possible usefulness of amniotic fluid concentrate preoperatively; but certain reasons exist which make its instillation at the close of the operation preferable.

When an incision is made into the peritoneum and the contents of the peritoneal cavity are, however slightly, exposed, there occurs an immediate, though perhaps imperceptible thermal and aqueous loss, causing some degree of disturbance in the normal physiology. Amniotic fluid con-

centrate adds a liquid substance at the very place where it was lost. It supports the intra-abdominal pressure, and to a certain extent the blood pressure. None of the patients described suffered shock following the use of amniotic fluid concentrate.

Even though there are no indications to suggest that amniotic fluid concentrate is able to dissolve adhesions which have developed previously, it prevents the formation of new ones. As new adhesions may be produced through the irritating effect of an inflammation, the preventive action of amniotic fluid concentrate may be traceable to its ability of forestalling the development of such inflammations. In this relation it is well to remember some of the properties of the human amniotic fluid. Over forty-one years ago, Bondi,[7] working in Schauta's clinic under very rigid precautions, established among the substances present in liquor amnii: pepsin, a diastatic ferment, a lipolytic ferment and a fibrin ferment. De Lee and Greenhill[8] ascribe to amniotic fluid an important bactericidal function during labor, as it washes out the vagina previous to the passage of the child, and thus acts as a preventive against infection of the child and the uterine cavity. This is not the place to enlarge on the problem of amniotic fluid concentrate in its relation to inflammation, a subject treated extensively by Rigdon and Warren.[9]

It may also be said that amniotic fluid concentrate probably exerts a mechanical influence, minimizing the effects of trauma. Meticulous care for the prevention of raw or oozing surfaces is a necessary precaution. Yet, if in spite of care such a condition should occur, the presence of amniotic fluid concentrate in the peritoneal cavity will separate the traumatized peritoneum from adjacent surfaces and at the same time stimulate the damaged surface into repair.

The experience gathered from the twenty-seven cases submitted here indicates, that the presence of amniotic fluid aids in restoring normal bowel movement. A natural movement was commonly obtained on the third day after operation. Often a movement which was soft to fluid was obtained on the second day.

In the early cases, 200 cc. of amniotic fluid concentrate were used. Later, the amount introduced whenever possible was 800 cc., and with the aid of the trocar it was frequently possible to instill the entire quantity. Various reasons led to preference of this larger volume. The area covered by the peritoneum is large. If it is true that the mechanical effect of the fluid in separating tissues exercises a beneficial influence, the instillation of the largest quantity possible must appear desirable, in order that the entire peritoneal surface may be in contact with the fluid. This large quantity supplies more fluid, more intra-abdominal pressure, and more local mechanical protection. Moreover, it has been observed that those patients who were given larger quantities recovered in shorter time and felt more comfortable during that period than those who received only 200 cc. However, it must be remembered that patients with a relatively small peritoneal cavity cannot accommodate 800 cc. and will do well on less. In Case XXII, 600 cc. were instilled. The patient suffered from ileitis and peritonitis, and it was believed that the use of amniotic fluid concentrate aided considerably in her recovery.

The cases in which amniotic fluid concentrate has been used, have shown less or no evidence of postoperative gastrointestinal symptoms (abdominal discomfort, indigestion, belching, intestinal stasis, or even constipation) compared with those not treated with amniotic fluid concentrate.

SUMMARY AND CONCLUSIONS

Twenty-seven cases of abdominal operations are described in which amniotic fluid concentrate was instilled intra-abdominally, immediately before the peritoneum was closed.

Instillation in the first eight cases was attempted by the funnel-and-catheter

method, the fluid reaching the peritoneum by gravity. In the remaining cases the fluid was instilled through a specially designed trocar, positive pressure being substituted for gravity. The later method, using the trocar and positive pressure, proved preferable to the earlier one which relied on the funnel and the aid of gravity alone.

I wish to acknowledge my sincere thanks to Dr. W. G. MacCallum for his constructive criticism, Dr. Leon Jones for many helpful suggestions, and to Mr. Jim Smith for aid in photography.

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If an extensor tendor is severed, a simple yet practical method is to suture the cut ends with stainless-steel wire, the same suture being made to unite the skin as well. Adequate splinting will prevent the tendon ends from pulling apart.

From "Minor Surgery," edited by Humphry Rolleston and Alan Moncrieff (Philosophical Library).

FRACTURES OF THE FEMUR

RESULTS OF TREATMENT OF 179 PATIENTS

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IT is generally conceded that femoral fractures are the most difficult of all in which to obtain good results. We wish to present the results of treatment of 184 fractures in 179 patients. These were treated from June 1, 1935, to May 1, 1942, on the Traumatic Service of the Charleston General Hospital.

In three patients both femurs were broken and two patients were treated twice for femoral fractures. There were twenty-eight fractures of the neck of the femur, thirty-six intertrochanteric fractures, twenty-three subtrochanteric and upper third fractures, sixty-nine in the middle third of the shaft and twenty-eight in the lower third of the shaft.

FRACTURES OF THE NECK OF THE FEMUR

The average age of the patients who suffered fractures of the femoral neck was fifty-nine. There were twenty-seven fresh fractures and one in which the diagnosis was not made for one year following injury. The original *x*-rays were negative and upon reviewing them after the fracture was found, the fracture line still could not be seen.

Following the Leadbetter reduction, a Smith-Petersen nail was inserted over a Kirschner wire by the blind method in thirteen patients. The results were excellent in three; that is, the patients could walk without pain and had no stiffness. In four cases, results were classified as good, there being some stiffness or pain. There were two cases rated as fair and three as poor. Aseptic necrosis of the head of the femur resulted in two cases. In one painful ankylosis followed and in the other cup arthroplasty was done elsewhere with a fair result. One patient died twelve hours following operation, apparently from an embolus.

Prior to the advent of the Smith-Petersen nail, the Leadbetter reduction and cast was carried out in seven cases, with one excellent, four good and two poor results.

The Roger Anderson well leg splint was used in one case but the result was poor.

In one case of impacted fracture in a man of forty-five, a Kirschner wire was inserted through the lower femur, but non-union resulted and a bone grafting operation was done later with a good result.

In the one case of non-union previously mentioned, a Lorenz osteotomy was done but the fracture failed to unite.

Comment. In spite of the introduction of newer methods of treatment, fractures of the neck of the femur are still difficult to treat. Of the twenty-eight cases, five had insufficient follow-up. The results then of twenty-three cases were as follows:

	No.	Per Cent		
Excellent	4	17.4		
Good	9	39.1		
Fair	2	8.7	Acceptable	56.5%
Poor	7	30.4		
Died	1	4.4		

The use of the Smith-Petersen nail affords firm fixation, but does not guarantee union, even though the patient be kept in bed three or four months postoperatively. Aseptic necrosis and non-union still result in many cases, probably due to interference with blood supply. It is our opinion that the fate of the fracture is decided at the time of the accident. Then, either the blood supply is so seriously impaired that no treatment will produce a good result, or the blood supply survives and with intelligent treatment, union will result.

The Leadbetter method of reduction and cast treatment deserves more praise than it has received. The reduction will in practically all cases correctly align the fracture fragments as shown by anteroposterior and lateral *x*-rays, and the cast treatment will produce good results in a high percentage of cases. It is unfortunate that it was introduced just at the time the internal fixation method was brought out. Otherwise it would have received greater fame, as it is clearly superior to the Whitman reduction and cast. The Roger Anderson well leg splint and the Kirschner wire traction should never have been used in treating these patients.

INTERTROCHANTERIC FRACTURES

There were thirty-six in this group and their average age was 60.5 years. It is in this type of fracture that the Roger Anderson well leg traction splint has its great value. We used it in twenty-two patients. Seven patients had spica casts, four had supportive treatment only, because of advanced age and poor condition, and one was treated by skin traction. As an experiment, early in the series, two patients were treated by ordinary Smith-Petersen nails. In one, the result was excellent but in the other a good deal of stiffness resulted. Ten patients died while under treatment. We found that many of the old people would develop pressure ulcers and die of inanition. They never became strong enough to sit up in wheel chairs at any time following operation. The results:

	No.	Per Cent		
Excellent	10	27.7		
Good	11	30.5		
Poor	2	5.5	Acceptable	58.2%
Died	10	27.7		
Unknown	4	8		

Comment. The Roger Anderson well leg splint was found to produce good apposition of the fragments, resulting in union if the patient could be kept alive. More recently we have used the Carl P. Jones traction splint in which no skeletal traction is necessary, but the casts have to be put on one day and the traction splint the next day, after the plaster has hardened. Thus the danger of infection about the pin is avoided but the treatment prolongs the period of discomfort to the patient before the traction is actually applied. We still prefer the well leg splint in which there is much displacement of fragments, necessitating strong traction.

The recent introduction of the flanged nail with a side arm running down the shaft for treating intertrochanteric fractures necessitates open operation, but if the patient can be gotten up to walk or at least sit up soon after operation, it may be that many of the pressure ulcers and deaths from inanition can be avoided. It remains to be seen whether or not these advantages will outweigh the extra risk of open operation.

SUBTROCHANTERIC AND UPPER THIRD FRACTURES

There were twenty-three in this group and their age averaged thirty-three years. We now get into the group of younger patients with better general condition and as a result better prognosis. The Roger Anderson double pin fixation with short cast was used in one case with a poor result. Kirschner wires were used in seven patients. The results in two were excellent, in three good and in one poor; this resulted in infection. In one case the position of the fragments was so poor that open operation and plating was done with a good end result. Skin traction was used in nine cases. There were four excellent, two good and one poor result. The latter was plated with a good result. Following traction, another femur was fixed by means of a Parham band with a good result. One of the patients treated by skeletal traction died. Of two patients treated with the well leg splint, the result was good in one and one had to be operated upon and a Parham band applied, finally healing in good position. In two patients the condition was so poor that supportive treatment only could be carried out. One patient, treated simply

by a spica cast received an excellent result. One non-union was plated with a good result. The results:

	No.	Per Cent		
Excellent	8	34.7		
Good	9	39.1		
Fair	1	4.3		
Poor	2	8.7	Acceptable	73.8%
Died	3	13		

Comment. As can be seen the results in this series were better than in the fractures of the neck or intertrochanteric areas, chiefly because the patients were younger. We have found considerable difficulty in holding fractures in the subtrochanteric area by skeletal traction in any form. These fractures are not common, and probably the best form of treatment is open operation with the use of vitallium plates and screws. We have had displacement to occur with one eight-hole plate in place, thus bringing up the advisability of using two plates, one on the anterior and one on the lateral surface of the femur. The leverage at this point is considerable due to the great length of femur below it.

FRACTURES OF THE MIDDLE THIRD OF THE SHAFT OF THE FEMUR

There were sixty-nine in this series, thirty-five being in children below fifteen years of age with an average age of five, and thirty-four above fifteen with an average age of thirty-four.

Under the age of six, bilateral skin traction, with the legs extended at the knees and flexed at the hips, was used in twenty-four cases, with twenty-two excellent results, one good result and one unknown. After three weeks in traction in these patients, spica casts were applied and worn six weeks.

In the adults, Kirschner wires through the lower femur were used early in the series. Of sixteen patients so treated, the results were excellent in six, good in five, fair in one and poor in three. Two of the latter were treated by open operation, a plate being applied in one and a Parham band in another. The end results in the two cases were good.

Russell traction with adhesive was carried out in eighteen cases with eight excellent results, seven good results, two fair results. The outcome of one case was undetermined.

The Roger Anderson double pin fixation was used in four cases. There was one good result, one fair result, in which infection developed around the upper pin, and two definitely poor results.

A simple spica cast was used in three cases with two excellent results and one good result.

Adhesive traction was used in three adults, with two excellent results and one good result.

In one patient no treatment except supportive could be carried out and he died of fat embolism, proved by autopsy.

The results:

	No.	Per Cent		
Excellent	40	59		
Good	20	29		
Fair	4	6	Acceptable	88%
Poor	2	3		
Died	1	1		
Unknown	2	2		

Comment. In children, the adhesive overhead, or Bryant's traction affords satisfactory results in practically every case. Even though some malposition or overriding occurs, the fracture unites quickly and any inequality is rapidly overcome.

We have proved that Russell traction is much the best form of treatment in middle third fractures in adults. The patients are more comfortable, the fragments become aligned more quickly and the knee does not become as stiff as when skeletal traction is used. The traction must be inspected frequently to keep all the angles correct; but if this is done, union results in a minimum of time and with comparatively little disability. To obviate the occasional difficulty caused by the adhesive slipping, we have recently applied the traction by means of a Kirschner wire through the heel. To keep the foot upright, however, it is necessary to apply a plaster boot, with a wood cross piece just proximal to the heel. If

this is not done, the foot will evert producing pressure on the lateral side of the wire causing pain and predisposing to infection. This method has not been used in enough cases to determine whether or not in the long run it will prove superior to the adhesive method.

FRACTURES OF THE LOWER THIRD OF THE FEMUR

There are twenty-eight in this series and their ages averaged 36.6 years. It is in this type of fracture that Russell traction is not so effective due to the persistent anterior or posterior displacement of the distal fragment. At first we used a single Kirschner wire through the distal fragment for longitudinal traction. Because of persistent displacement anteriorly or posteriorly of one or both fragments, one of us (H. A. S.) devised a method whereby a second wire was placed through either the distal end of the proximal fragment or the proximal end of the distal fragment and pull was made anteriorly or posteriorly, as the case demanded.[1] Later a third wire was added so that anterior and posterior pull, as well as longitudinal pull could be made simultaneously. The two wire technic has been used in four cases and the three wire technic in four cases, all with good results. However, because the second and third wires must be introduced with the leg in traction, it is difficult to preserve complete asepsis, and infection has resulted in two cases. In one it was of the soft tissues only and quickly cleared up, but in the other chronic osteomyelitis developed necessitating sequestrectomy.

Kirschner wires were used in fifteen of the twenty-eight cases. There were six excellent results, four good results and two fair results. In one case a plate had to be applied, in another a Parham band, following failure of single wire traction. These were done before the multiple wire technic was introduced.

The Roger Anderson double pin method was used in two cases with poor results. In both the method was changed to Kirschner wires with good results.

Russell traction was used with excellent results in two cases, good results in four cases and a poor result in one case. This patient developed gangrene of the lower leg and foot due to injury to the blood supply and amputation was necessary.

One other leg was amputated because of severe maceration of soft tissues.

A long leg cast was used in one case with a very good result and a spica cast was used in two cases with excellent results in both.

The results:

	No.	Per Cent		
Excellent	8	28.6		
Good	12	42.8		
Fair	3	10.7	Acceptable	71.4%
Poor	2	7.1		
Unknown	3	10.7		

There were five compound fractures of the femur. These wounds were all carefully débrided and washed out. One in the upper third was treated by Kirschner wire traction with an excellent result. Another in the upper third was treated with a Kirschner wire, but infection developed in the wound and the subsequent use of the leg was only fair. Another patient with an upper third fracture died of shock. One lower third fracture could not be aligned by wire traction, but obtained a good result following plating after the wound had healed. The fifth, a fracture of the lower third, resulted in amputation.

CONCLUSIONS

The use of the Smith-Petersen nail is still the best method of treating fractures of the neck of the femur, although there have been many failures even when this method is efficiently used. Certain factors militate against success in treating this fracture no matter what is done.

The Roger Anderson well leg splint was used successfully in intertrochanteric fractures in patients who could be kept alive. We have had no experience with the use of Smith-Petersen nails with side arm exten-

sions, but if following this operation patients can be made ambulatory, better results should be expected.

In treating subtrochanteric fractures, it is our opinion that open operation with the use of two vitallium plates is the method of choice.

Our results with Russell traction in the treatment of upper and middle third fractures have been so good that we are enthusiastic about the method. Union results in a comparatively short time and the degree of knee stiffness is less than when other methods are used.

Disability following fractures of the lower third of the femur is still high, but we have obtained good anatomical position of the fragments with the use of two and three wire Kirschner traction as described.

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Suspect fracture of the os calcis after a fall in the standing position, even when there is no deformity of the foot. Also suspect fracture of the spine after every injury of this nature. Do not manipulate the foot for several days or even apply plaster of Paris, until the bogginess of the heel has subsided with rest and elevation in bed.

From "Fractures and Dislocations for Practitioners," by Edwin O. Geckeler (The Williams & Wilkins Company).

EFFECTS OF SULFANILAMIDE AND AZOCHLORAMID UPON HEMOLYTIC STREPTOCOCCI AND STAPHYLOCOCCI IN WOUNDS OF RABBITS*

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THE problem of prevention and treatment of wound infections is of paramount importance at the present time. During the last few years sulfonamides have been extensively used both systematically and locally. Although many publications are available attesting to the usefulness of these drugs, other observers have reported more or less disappointing results, particularly as far as their effects on localized infections are concerned.

Several successful attempts have been made recently to enhance the antimicrobial activity of sulfonamides. It has been shown that the combined use of sulfonamides and certain disinfectants may yield results superior to those obtained with either drug alone. Tenenberg, Tsuchiya, Clark, and Strakosch[1] demonstrated the synergistic action *in vitro* of sulfonamides and urea. Clinically, Holder and MacKay,[2] Strakosch and Clark,[3] and Ilfeld[4] have used urea and sulfonamides in combination with gratifying results. Sulfonamides and azochloramid, too, act synergistically *in vitro* (Schmelkes and Wyss,[5] Neter[6,7]). It seemed of interest, therefore, to determine their effects under *in vivo* conditions. The following experimental investigation is concerned with the antimicrobial action of sulfanilamide and azochloramid, alone and in combination, upon hemolytic streptococci and staphylococci in wounds of rabbits. The results of this study are herewith presented.

MATERIAL AND METHODS

All experiments were carried out on medium-sized rabbits. The following method was used to produce artificial wounds: The hair was removed with scissors over a large area of the dorsum of the rabbit extending from the neck to the rump and laterally to the flank. At selected places at both sides of the midline the skin was held by a forceps and removed with scissors so that a circular wound measuring approximately 10 to 15 mm. in diameter resulted. Usually no bleeding occurred from this procedure. The wounds were then infected with broth cultures of either hemolytic streptococcus or staphylococcus.* In some of the experiments a sterile swab was saturated with the broth culture and applied to the wound. In others, several drops of the culture were rubbed in with a sterile swab. The majority of experiments were carried out with beta hemolytic streptococcus. Several strains were employed. On strain, C_{203}, was obtained through the courtesy of Dr. Eleanor A. Bliss, Johns Hopkins University. The others were freshly isolated from patients with streptococcal infections. Strains of pathogenic (coagulase-positive) staphylococci, recently obtained from children with staphylococcal infections, were also used.

* A box was designed and constructed by one of us (T. G. L.) to restrain the rabbit from interfering with the experiment. The head of the rabbit was kept in a stock.

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Two preparations of azochloramid-sulfanilamide powder* of the following composition were used:

Sulfanilamide USP	75.0%
$CaCO_3$	10.0%
Urea	9.5%
Na_2HPO_4	5.0%
Na tetradecyl sulfate	0.3%
Azochloramid (N, N'-Dichloroazodicarbonamidine)	0.1%
Sulfanilamide	84.5%
$CaCO_3$	10.0%
Disodium phosphate	5.0%
Na tetradecyl sulfate	0.3%
Azochloramid	0.2%

Sulfafilm containing 15% of sulfanilamid, buffered to pH 8.5–9, as well as control film without sulfanilamide, were also supplied by Wallace & Tiernan Products, Inc.

In order to determine the effects of sulfonamides and azochloramid upon streptococci and staphylococci in wounds, cultures were made prior to and during therapy. Sterile swabs were applied to the wound and rubbed with firm pressure. When crusts were present they were first removed and the culture was taken from the exposed wound. Blood agar was then inoculated from this swab. The culture medium was prepared with 5 per cent human blood; it contained para-aminobenzoic acid to counteract any possible antimicrobial effects resulting from the presence of sulfonamides in the inoculum. In some experiments sodium sulfite was added to the agar to render azochloramid ineffective. The agar plates were incubated at 37°C. for several days and the resulting growth was noted at intervals.

EXPERIMENT

In preliminary experiments it was determined whether artificial wounds in rabbits could be infected with the strains of hemolytic streptococci and staphylococci available for these studies. Since undiluted eighteen to twenty-four-hour broth cultures were employed, it is evident that a large number of organisms were used for infecting purposes. It was noted that this method resulted in the presence of numerous viable micro-organisms in the wounds for at least forty-eight hours. Purulent infection usually did not develop and the number of viable organisms decreased within two to four days even without treatment.

In the first experiment the effects of azochloramid powder on hemolytic streptococcus in wounds of rabbits were studied. An eighteen-hour infusion broth culture of beta hemolytic streptococcus (C_{203}) was used. One wound was treated with this drug, the other served as control. The wounds were cultured for the presence or absence of hemolytic streptococci on blood agar containing para-aminobenzoic acid and sodium sulfite, after the azochloramid powder has been removed mechanically. Then, azochloramid powder was reapplied to the wound. The results of this experiment are presented in Table 1.

Table 1

Effect of azochloramid powder on hemolytic streptococcus in wound of rabbit

Culture of Na_2SO_3 Blood Agar	Wound Treated with Azochloramid	Control Wound
1. Immediately after treatment.	Many hem. strep.	Very many hem. strep.
2. 5 minutes after treatment.	Few hem. strep.	Very many hem. strep.
3. 30 minutes after treatment	No. hem. strep.	Very many hem. strep.

It is evident from this table that (1) hemolytic streptococci were still present immediately after azochloramid was applied, (2) exposure of the wound to azochloramid powder for five and thirty minutes, respectively, resulted in a marked reduction in the number of viable hemolytic streptococci, and (3) a large number of hemolytic streptococci were present in the control wound. Thus, azochloramid exerted definite anti-streptococcal activity

* Azochloramid as well as azochloramid-sulfanilamide powder was supplied by Wallace & Tiernan Products, Inc., through the kindness of the late F. C. Schmelkes and of L. Reiner.

in vivo. This conclusion is based on two facts: (1) the observation that immediately after the drug was applied many hemolytic streptococci were still present and (2) that sodium sulfite was used in the culture medium to counteract the bacteriostatic effects of azochloramid *in vitro*.

Since *in vitro* experiments had revealed that azochloramid and sulfonamides act synergistically, the effects of these two drugs, alone and in combination, on hemolytic streptococcus were investigated. The results of such an experiment are summarized in Table II.

TABLE II

EFFECT OF SULFANILAMIDE WITH AZOCHLORAMID POWDER ON HEMOLYTIC STREPTOCOCCUS IN WOUND OF RABBIT

Culture on Blood Agar	Wound Treated with Azochloramid	Wound Treated with Sulfanilamide	Wound Treated with Sulfanilamide and Azochloramid	Control Wound
1. Few minutes after treatment.	Many hem. strep.	Very many hem. strep.	Rare hem. strep.	
2. 24 hours after treatment.	Rare hem. strep.	Very many hem. strep.	Few hem. strep.	Many hem. strep.
3. 48 hours after treatment.	Rare hem. strep.	Very many hem. strep.	Many hem. strep.	Very many hem. strep.
4. 72 hours after treatment.	No hem. strep.	Rare hem. strep.	Rare hem. strep.	No hem. strep.

It may be seen from this table that sulfanilamide powder alone failed to reduce materially the number of hemolytic streptococci in the wound over a period of forty-eight hours; in contrast, azochloramid powder alone, as well as azochloramid powder used in conjunction with sulfanilamide, caused a definite reduction in the number of organisms twenty-four hours after treatment was begun. It must be emphasized, however, that certain irregularities occurred. For instance, the wound treated with azochloramid and sulfanilamide after forty-eight hours again harbored many hemolytic streptococci. In all, thirty-five such experiments were carried out. It is evident from these experiments that, generally speaking, azochloramid powder definitely reduced the number of hemolytic streptococci present in such wounds; furthermore, no evidence has been obtained indicating that the combined use of azochloramid and sulfanilamide resulted in greater antimicrobial effects than that obtained with azochloramid alone. This may be due to the fact that azochloramid in itself proved to be efficacious and that additive effects from the additional use of sulfanilamide escaped detection. Furthermore, it must be noted that even in the control wounds hemolytic streptococci had practically disappeared after seventy-two hours and it is quite possible that sulfonamides exert their anti-streptococcal activity especially after a lapse of several days.

Recently, films impregnated with sulfonamides have been introduced in the prevention of wound infections. It was decided, therefore, to study the effects of such a preparation, sulfafilm, on hemolytic streptococcus in wounds of rabbits. The experiment itself was carried out as follows: Five wounds were infected with a freshly isolated strain of hemolytic streptococcus. One of the wounds served as control, the others were treated with (1) sulfafilm, (2) sulfanilamide-azochloramid powder, (3) sulfanilamide-azochloramid powder and sulfafilm, and (4) sulfanilamide-azochloramid powder and control film, respectively. Cultures were taken at various intervals. The results are presented in Table III. It is evident that sulfafilm itself failed to reduce the number of hemolytic streptococci in wounds. Azochloramid-sulfanila-

mide powder alone, or used in conjunction with sulfafilm and control film caused a marked decrease in the number of hemolytic streptococci. There was no evidence that the use of sulfafilm increased the antimicrobial effects of azochloramid-sulfanilamide powder. In other experiments, wounds treated with azochloramid powder and sulfafilm contained fewer hemolytic streptococci than those treated without the film. However, the results were inconsistent and control film produced similar effects.

In the last series of experiments the effects of azochloramid and sulfanilamide on staphylococci in wounds of rabbits was investigated. The results of a representative experiment are presented in Table IV. This table shows that sulfafilm alone had no noticeable effect on the number of staphylococci present. Sulfanilamide-azochloramid powder caused only transitory reduction in the number of organisms present. The additional use of sulfafilm did not inhance the activity of sulfanilamide-azochloramid powder. Similar results were obtained in repeated experiments.

TABLE III

EFFECT OF SULFANILAMIDE WITH AZOCHLORAMID AND SULFAFILM ON HEMOLYTIC STREPTOCOCCUS IN WOUND OF RABBIT

Culture on Blood Agar	Wound Treated with Sulfafilm	Wound Treated with Sulfanilamide and Azochloramid	Wound Treated with Sulfanilamide, Azochloramid and Sulfafilm	Wound Treated with Sulfanilamide, Azochloramid and Control Film	Control Wound
1. Few minutes after treatment.	Very many hem. strep.	Moderate number of hem. strep.	No hem. strep.	Moderate number of hem. strep.	Very many hem. strep.
2. 24 hours after treatment.	Very many hem. strep.	No hem. strep.	No hem. strep.	No hem. strep.	Very many hem. strep.

COMMENTS

The problem of the most effective measures for the prevention and treatment of wound infections is still in a state of flux. Its significance at the present time cannot be overestimated. On the one hand, there have been published during the last few years favorable reports concerning the efficacy of sulfonamides applied locally or given systemically. On the other hand, it has been shown by other authors that these drugs failed materially to reduce the number of pathogenic micro-organisms in wounds. The subject of sulfonamide therapy in wound infections has been reviewed recently by Lyons,[8] Long,[9] and Lund.[10]

TABLE IV

EFFECT OF SULFANILAMIDE, AZOCHLORAMID AND SULFAFILM ON STAPHYLOCOCCUS IN WOUND OF RABBIT

Culture on Blood Agar	Wound Treated with Sulfafilm	Wound Treated with Sulfanilamide and Azochloramid	Wound Treated with Sulfanilamide, Azochloramid and Sulfafilm	Control Wound
1. Few minutes after treatment	Very many staph.	Scattered staph.	Rare staph.	Very many staph.
2. 24 hours after treatment.	Very many staph.	Very many staph.	Many staph.	Very many staph.

Jensen, Johnsrud, and Nelson[11] were among the first to use sulfonamides locally in compound fractures with gratifying results. Sulfonamides were recommended for the prevention and treatment of wound infections by Long,[9] Riba and Aten,[12] Green and Parkin,[13] Weil, Whitaker, and Rusbridge,[14] and the National Research Council, Committee on Chemotherapeutic Agents,[15] among others. Meleney,[16] before the Buffalo Academy of Medicine, reported that our figures give no indication that the sulfonamide-treated patients had a lower incidence of local wound infection than the control cases, and the important bacteria were not more completely eliminated from the wounds in the drug-treated patients than from the controls without the drug.

Experimentally, McSwain and Glenn[17] studied the effects of local implantation of sulfadiazine in streptococcal infections. These authors found that this treatment reduced the mortality rate from 100 to 66 per cent and 83.4 per cent, respectively, depending upon the time elapsing before treatment was begun. Implantation of sulfadiazine also lowered the incidence of positive blood cultures from 100 to 50 per cent. It is noteworthy that this form of therapy had very little influence on the micro-organisms present in the wound. The incidence of positive wound cultures was reduced from 100 to only 83 per cent, 91.7 to 100 per cent. Thus it is evident that local sulfathiazole therapy influenced the systemic infection to a greater extent than the local infection.

Daniel, Billings, and Crutcher[18] investigated the local effect of sulfanilamide, sulfathiazole, and sulfadiazine upon hemolytic staphylococcus aureus infections of the pleural cavity. They found that local use of sulfathiazole is more effective in preventing hemolytic staphylococcal empyema following pneumonectomy in the dog than are either sulfanilamide or sulfadiazine. Sulfanilamide proved least efficacious.

Lord, Blakemore, and Stefko[19] investigated the effect of sulfonamides in wounds using the non-suture method of bridging a gap in the several femoral artery twenty-four hours after its unsterile ligation and division. They found that in the undébrided wound local implantation of sulfanilamide was of little value in regard to the healing of the wound, whereas, in the carefully débrided wound sulfanilamide applied locally was of significant value. It is worth noting that sulfathiazole administered orally was slightly more efficacious than sulfanilamide implanted locally.

The above reported experiments were undertaken to compare the antimicrobial effects of sulfanilamide and azochloramid upon hemolytic streptococci and staphylococci in wounds of rabbits and to determine whether these drugs act synergistically *in vivo* as they do *in vitro*. The investigations revealed that against hemolytic streptococcus, isolated from human sources, sulfanilamide powder as well as sulfafilm failed to cause a noticeable reduction in the number of organisms present. It must be stressed, however, that in these experiments the infection was self-limited, since the organisms disappeared without treatment after several days. Furthermore, it is noteworthy that the artificial wounds were infected with large numbers of hemolytic streptococci. In contrast to sulfanilamide, azochloramid powder as well as azochloramid-sulfanilamide powder markedly reduced the number of hemolytic streptococci present in such wounds. Against pathogenic staphylococci azochloramid was less effective than against hemolytic streptococci. This drug only temporarily reduced the number of staphylococci in wounds of rabbits.

Under the conditions of these experiments the simultaneous use of azochloramid and sulfanilamide did not produce better results than did azochloramid alone. Several possibilities have to be considered to explain this observation: First, it is possible, although unlikely, that these drugs do not act synergistically *in vivo* as they do *in vitro*. Secondly, it may be

that the synergistic action escaped detection since azochloramid alone usually produced a marked reduction in the number of organisms. It remains to be determined, therefore, whether synergistic effects can be demonstrated in experiments in which slightly effective amounts of azochloramid are employed.

In this connection it is worth mentioning that mixtures of azochloramid and sulfanilamide, both in powder form and in solution (triacetin), have been used in the treatment of wound infections at this hospital in several cases. The treatment was well tolerated and the results, by and large, were very encouraging. The treatment seems to be of value particularly prior to grafting.

From the data presented here it is evident that azochloramid powder is definitely more efficacious toward hemolytic streptococci and staphylococci in wounds of rabbits than is sulfanilamide. It is reasonable to suggest, therefore, that azochloramid or other oxidizing agents, alone or in conjunction with sulfonamides, be studied further as antimicrobial agents for the prevention and treatment of wound infections.

SUMMARY

The effects of azochloramid powder, sulfanilamide powder, and sulfafilm, alone and in combination, on beta hemolytic streptococci and staphylococci of human origin in artificial wounds of rabbits were investigated. The following results were obtained:

1. Hemolytic streptococci were present in infected wounds for two to four days and then disappeared without specific treatment.

2. Within an observation period of twenty-four to forty-eight hours sulfanilamide powder and sulfanilamide-impregnated film failed materially to reduce the number of hemolytic streptococci in such wounds.

3. Azochloramid powder and azochloramid-sulfanilamide powder caused a marked reduction in the number of organisms present.

4. The experiments did not reveal any synergistic action of azochloramid and sulfanilamide on hemolytic streptococci in such wounds.

5. Wounds infected with human pathogenic staphylococci were similarly treated. Sulfanilamide powder and sulfafilm proved to be ineffective. Azochloramid powder and azochloramid-sulfanilamide powder caused only a moderate and temporary reduction in the number of organisms.

6. Mixtures of azochloramid and sulfanilamide have been used with encouraging results in the treatment of wound infections in children.

7. The significance of the results is discussed.

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The response to the treatment of varicose ulceration depends on its duration, the extent of the ulceration, and the condition of the surrounding tissues in terms of scarring, phlebitis and lymphatic obstruction.

From "Minor Surgery," edited by Humphry Rolleston and Alan Moncrieff (Philosophical Library).

BENIGN TUMORS OF THE STOMACH

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THE importance of benign tumors of the stomach has repeatedly been emphasized in the literature. The main reasons for this fact are evidently: first, the severity of the symptoms and second, the frequency of malignant degeneration.

Lesions of this kind are relatively rare. They may appear singly or in multiple form, submucous or subserous, sessile or pedunculated. Their incidence is variously estimated at from 0.5 to 5 per cent of gastric neoplasms. Finesilver, at the New York Hospital, reports an estimated 43,200 gastrointestinal *x*-ray series taken in the course of eight years, of which only six showed benign tumors. In addition, there were in this series three cases which had undergone malignant change. The ratio of malignant to benign tumors was 66 to 1. Root, at the Cleveland Clinic, found only seventeen benign gastric tumors in 250,000 admissions, and of these twelve were proved at operation or autopsy. Lahey and Colcock quote Rigler and Erickson who, in 6,742 autopsies at the University of Minnesota found that benign tumors formed 26 per cent of gastric neoplasms. Many of the benign tumors encountered at autopsy are leiomyomas of less than 1 cm. in diameter, which had caused no clinical symptoms.

These benign tumors are classified as epithelial, mesenchymal and endothelial. Of these the leiomyomas are the most common, adenomas and papillomas come next in frequency, while neurofibromas and hemangiomas are quite rare.

Little is known concerning the etiology of these tumors. Considerable experimental work has been done with rats and mice, using roughage and unbalanced or deficient diets. Brunschwig and Rasmussen conclude that no proof exists that deficiencies in vitamins A, B_1, B_2, C or D are definite factors in the development of these tumors.

Atrophic gastritis is a common finding accompanying benign tumors of the stomach. Schindler, in examining 2,167 stomachs gastroscopically, found thirty-six adenomatous polyps, an incidence of 1.65 per cent. Two-thirds of these cases showed atrophic gastritis. Among a total of 310 patients suffering from atrophic gastritis, adenomatous polyps were present in 4.8 per cent. Of forty-three patients with pernicious anemia and severe widespread atrophic gastritis, 14 per cent had benign adenomatous polyps. Thus, adenomatous polyps are seven times more frequent in association with atrophic gastritis than in the presence of a normal mucosa.

Ulceration of the mucous membrane over the surface of these tumors is quite common and tends to be deeply penetrating.

Malignant change or degeneration in benign tumors of the stomach is frequently encountered. Lahey and Colcock found sarcomatous degeneration in five out of seven leiomyomas. Eliason and Wright, as quoted by Lahey and Colcock, report malignant change in 35 per cent of adenomatous polyps. McRoberts, of the Mayo Clinic, as quoted by Finesilver, classed four out of five adenomas as malignant. Such malignant transformation is encountered in similar manner in the less common fibromas, neurofibromas and hemangiomas.

Symptoms vary according to size, the location, the presence of ulceration, the presence of atrophic gastritis and are also dependent upon the tumor being either sessile or pedunculated. The average case will have been subject to symptoms for

about eighteen months. Some form of dyspepsia is usual and vomiting occurs in about one-third of all cases. Many have been treated for peptic ulcer for some time, with varying relief. Anemia is the most common finding. Bleeding in ulcerated cases may either be mild or severe. Unexplained anemia may be the only sign, and benign tumor of the stomach must be kept in mind as a possible source of bleeding in such cases. Finesilver quotes Benedict and Allen, of the Massachusetts General Hospital, as reporting primary anemia as the first diagnosis in 30 per cent of their cases. On the other hand, severe hemorrhage with hematemesis and melena is not uncommon and may even be fatal. In approximately 10 per cent of these cases pedunculated tumors near the pylorus cause obstruction of the ball-valve type, usually intermittent in character. In these cases pain may be a prominent complaint. Prolapse of the tumor through the pylorus and even intussusception have been described.

In the diagnosis, roentgen ray and gastroscope are most important. The roentgen findings are characteristic and consist of smooth, punched out filling defects, most easily seen in the partially filled stomach. Peristalsis is only slightly interfered with, and surface ulcers are readily demonstrated. Rugae commonly are normal to the base of the tumor. The gastroscope is of value, especially in viewing the smaller tumors. Large tumors may be seen only in part and in such cases roentgen examination is more trustworthy. Laboratory findings are variable. Achlorhydria and anemia are frequently noted.

Benign tumors of the stomach are rarely palpable save at operation. Even with the tumor under vision, at the operating table, it is difficult to arrive at an accurate diagnosis concerning this group of gastric neoplasms. For this reason, it is generally agreed that one must depend upon histological examination for final diagnosis. Enlarged inflammatory lymph nodes may be present, making a benign ulcerated tumor appear malignant, yet metastases may be present in a tumor seemingly benign.

Surgical treatment of these cases is generally satisfactory and the mortality low. Some writers urge gastric resection, giving these tumors a wide berth; others believe that simple, local resection of the lesion is adequate and less hazardous. Zollinger, in summing up the problem, writes: "The type of surgery carried out will depend on the extent of the lesion, its location and its probable chance of being malignant." Frozen section may be of aid, but is not entirely reliable in differentiating between benign tumors and the lower grades of malignancy.

The following case reports are from the files of the Huntington Memorial Hospital in Pasadena, California, and include all cases of this type, admitted during the past twenty years. It should be noted that two out of four myomas of the stomach had undergone malignant degeneration.

CASE REPORTS

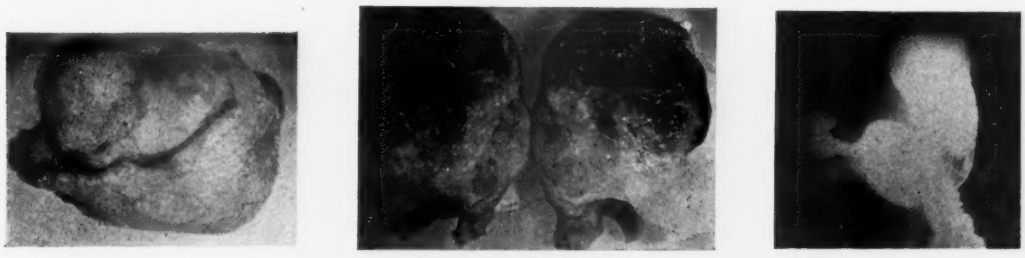
Case I. J. R., seventy years of age, male, upon his first admission, stated that six months previous he had passed a large dark stool and had several black tarry stools since. At 4 A.M. he vomited a large amount of bright red blood and was very weak and unable to walk. *X*-ray suggested a possible benign myoma. Operation was advised and refused. The patient remained in the hospital eight days.

He was readmitted twenty-five months later. He had been well since last hospitalization until three weeks before this admission when he felt weak and faint. He experienced pain in the epigastrum, nausea, and vomited a quantity of blood and later passed a tarry stool. He had been able to eat little since and had lost considerable weight. Hemorrhages had been repeated. *X*-ray showed that the tumor still had benign characteristics.

At operation a local excision was performed and the histology proved the presence of myoma of the stomach with malignant degeneration and ulceration. (Figs. 1A, B and C.)

Case II. S. D., a sixty-seven year old female, complained of loss of appetite, diarrhea, and sense of a lump in the left side for the past

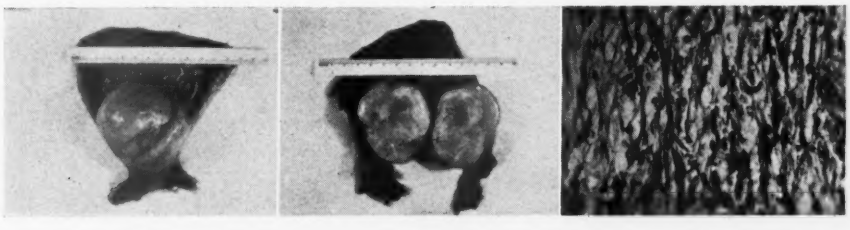
four months. The feeling in the upper abdomen was the same as when she felt life during pregnancy. Weight loss had been eight pounds. Repeated hemorrhages occurred since, combined with epigastric pain. Her condition was poor on admission, red blood count 1,680,000;



A B C

Fig. 1. A, gross appearance of tumor; B, tumor sectioned, showing hemorrhagic infiltratration; C, roentgenogram.

A movable, non-tender, firm mass 7 cm. in diameter, was palpable beneath the left costal margin. It could be pushed to the mid-line and down to the umbilicus. There was marked Paget's disease in both legs, especially the right. Colon x-ray was negative. hemoglobin 32 per cent. Repeated transfusions were given, but the patient went steadily down, dying of hemorrhage. No operation was performed, the red blood count was 640,000; hemoglobin was not readable. The autopsy specimen showed malignant myoma of the



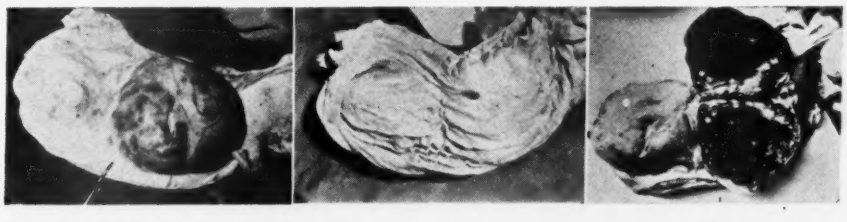
A B C

Fig. 2. A, gross appearance of mucosal surface; B, tumor sectioned; C, microphotograph.

Sleeve resection was carried out and a subserous discrete, firm, rounded tumor was found arising from the posterior wall of the fundus of the stomach. The serous surface was nodular, suggesting possible invasion of serosa. The histological picture was that of a benign myoma and chronic gastritis. (Figs. 2A, B and C.)

Case III. F. E., a fifty-five year old female, had a sudden onset of nausea, hematemesis and epigastric pain four days before admission. stomach with ulceration. (Figs. 3A, B and C.)

Case IV. F. B., a sixty-seven year old male, had passed black tarry stools and suffered with some gas and discomfort six months previously. The night before hospitalization he passed a similar black stool, at 8 P.M. He felt uncomfortable later in the night and went to the bathroom, where he was found unconscious lying in a pool of blood, at 5.30 A.M. A blood transfusion was given.



A B C

Fig. 3. A, serosal surface; B, mucosal surface, showing ulceration; C, tumor section showing hemorrhagic infiltration.

X-ray showed tumor of the stomach wall with ulceration.

The patient gradually improved and left

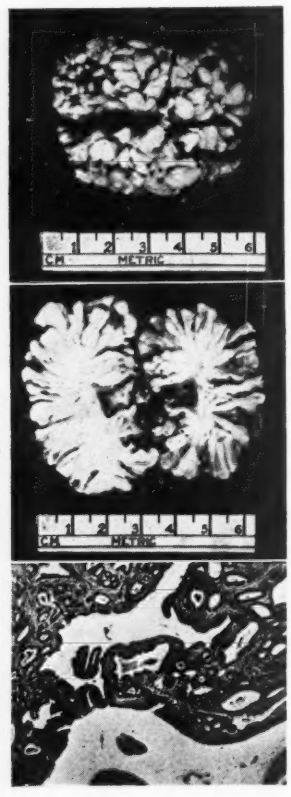


FIG. 4. A, gross appearance; B, tumor sectioned; C, microphotograph.

the hospital on the thirty-seventh day. He returned three months later with a red blood count of 3,640,000 and hemoglobin of 45.4 per cent. Operation was performed and transfusions given. The histological picture was that of fibromyoma of the stomach, benign. No photographs were available in this case.

CASE V. F. H., a fifty year old male, had had intermittent periods of sharp mid-epigastric pain, gaseous distention and recurring constipation for nine months. The pain occurred usually in the morning and was aggravated by the ingestion of food. There were no nausea, vomiting, nor tarry stools.

X-ray showed a defect consistent with tumor encroaching upon the lumen of the stomach. During local excision a soft pedunculated tumor on the posterior wall was removed. The histological picture was that of a benign papilloma. (Figs. 4A, B and C.)

CONCLUSION

Benign tumors of the stomach while rare, are important. The symptoms they produce may be severe. Malignant degeneration is frequently encountered. Their surgical treatment is satisfactory and the mortality is low.

More frequent roentgen and gastroscopic study of the stomach in cases of unexplained anemia and chronic dyspepsia is urged.

Appreciation is expressed to Dr. J. H. Breyer, Dr. S. J. Mattison and Dr. C. C. Snyder for the use of their material along with my own, and to the Pathology Department for aid in preparing the photographs.

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PSYCHOLOGY OF THE PATIENT UNDERGOING PLASTIC SURGERY

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IN recent years medical literature has revealed a decided increase in the number of articles on the subject of plastic surgery. For the most part the papers deal with specific technical problems, and little has been written on the psychology of the patient undergoing plastic surgery. It is not the intent here to convey the impression that this paper constitutes a thorough study of the psychology of such a patient. The purpose is merely to call attention to certain facts, some perhaps well known, others less well known, and still others scarcely realized.

As surgeons, we are all too prone to look upon the patient as a case of this or that type of disfigurement. We see only "the point of our knife." Yet the genuine success of the surgical treatment cannot be measured in terms of physical results alone.

The surgeon knows what he may expect to do for his patient physically. But why a more or less identical result, honestly satisfactory from the surgeon's standpoint, will satisfy one patient yet not another; why in this respect the surgeon is successful with one patient and not with another; why some patients continue to drift from one surgeon to another without, apparently, getting relief, all these questions cannot be settled from a consideration of the physical defect and the surgical treatment alone. And this problem becomes even more puzzling when the surgeon recalls certain cases in which the physical results were not, from his point of view, entirely satisfactory but in which, nevertheless, the patient felt much improved and free from the mental distress which he had previously experienced.

To dismiss casually the patient who is unhappy over the results of a plastic operation by saying that such a patient is ungrateful or "crazy" is generally to evade the real issue. Not only must the surgeon ask himself, has the operation been honestly executed, and is he himself sincerely satisfied with the surgical result? But he must search his memory and conscience further. Was the outcome clearly prophesied to the patient? Was the patient at any time misled to expect a better result? And there are still further questions: Was surgery really needed in the first place? Has the surgeon a clear insight into the patient's mental attitude and has he had it from the very beginning?

Our discussion, then, makes no claim to completeness, but it does attempt to set down a few observations concerning the psychology of the patient, and these observations may be grouped about the following problems: (1) Objective considerations, i.e., the physical disfigurement itself and related factors; (2) subjective considerations, such as anxiety and related fears; (3) the relation between disfigurement and mental distress, or between subjective and objective conditions.

THE PHYSICAL DISFIGUREMENT

No hard and fast rule can be set down as to what constitutes a genuine disfigurement. In contrast to large and obvious defects, there are others so slight that one's attention must literally be called to them. And between these two extremes lie all possible gradations. The dividing line between a genuine defect and a fancied one is sometimes very vague. A condition which to the surgeon may seem of slight import, may be of tremendous significance to the patient.

There is in most of us a very human desire to conform to the standards of our society. We are not here concerned with the question of what factors mould our concept of desirable "looks"; that would involve a discussion of fashion, the arts, the dominant social group, etc. But whatever the genesis of the standard physical pattern, both from the general social standpoint and from the individual's standpoint, failure to conform to the accepted pattern sets one apart in one's own estimation, and is often the basis for feelings of acute anxiety.

From an objective point of view alone, the surgeon must consider first of all the disfigurement itself and the possibility of repair *if such repair is at all possible.* Certain practical considerations should be taken into account: the patient's age, sex, occupation, social position, his economic and marital status. From a purely objective point of view, repair might seem to be more important in the case of a young person who has his life to live than in the case of an old person whose life is largely behind him, and, given our social order, more important to a woman than to a man. From this external point of view it might also seem that surgical repair of a defect is more urgent in certain occupations than in others, let us say, for instance, more essential to an actress or to a personage in public life than to a dishwasher or a housewife. But from a subjective point of view this may not be true.

SUBJECTIVE CONSIDERATIONS

Just as important as the objective consideration of a defect, is the surgeon's understanding of the patient's mental attitude. In the final analysis, what constitutes a disfigurement rests in large measure with the patient's reaction to that real or fancied disfigurement. We must constantly bear in mind that the patient's attitude toward the physical problem is based not only upon the objective extent of that problem but on related subjective factors of personal adjustment to the outer world.

The plastic surgeon who contemplates the operative treatment of a patient suffering from a real or fancied disfigurement must make every effort to comprehend that patient's mental attitude. While he cannot be expected to be a psychiatrist, the surgeon must never permit his point of view to be restricted to mere consideration of the actual physical repair alone. He must adopt a broader outlook and *treat the patient,* not merely the local condition.

For the patient's mental attitude is of crucial importance. It is the mental attitude which accounts for the fact that a patient will readily submit to extensive surgery. In that initital attitude, the patient undergoing plastic surgery differs from the ordinary surgical patient, for the former comes to the surgeon in the hope that he will be subjected to operation, whereas the general surgical patient comes to the surgeon in the hope that he will be told no surgery is necessary. The one courts surgery, the other dreads it. This desire on the part of the patient for plastic surgery renders him peculiarly vulnerable, since those whose commercial ability far exceeds their professional skill may take advantage of his eagerness.

Moreover, the patient is often inclined to expect too much from the surgeon. His expectation may be beyond the surgeon's ability to fulfill, either because there is no actual surgical solution for the physical problem, or because surgical repair, even if possible, cannot solve that patient's psychological problem. As regards the first factor—the possibility of physical repair—the surgeon's approach must be cautious. When the general question of repair is discussed, the prognosis should be scrupulously presented. For instance, if grafting of tissue is indicated, the possibility, if any, of disfigurement in the donor area should be pointed out. Hospitalization, postoperative discomfort both from the operation itself and from possible immobili-

zation should be considered. And, so far as possible, the final result must be described. These points should be presented to the patient as simply and as clearly as possible, without minimizing them.

DISFIGUREMENT AND MENTAL DISTRESS

So much for the question of physical repair. But the patient who has a physical disfigurement has an accompanying anxiety, a mental distress, for as we have seen it is because of his mental reaction to the disfigurement that the patient seeks plastic surgery, and even where complete surgical repair is possible, it may not solve the patient's psychological problem. The terms distress and anxiety are used here in a broad sense, including such mental and emotional attitudes and mechanisms as inferiority, shame, overcompensation; and such psycho-emotional traits as an anti-social tendency, social insecurity, general maladjustment. One might be inclined to assume that the anxiety ought to bear a definite proportional relationship to the disfigurement. Strangely enough, this is not always the case; there is no definite proportional relationship between the disfigurement and the mental attitude it engenders. What to the surgeon may appear an almost insignificant disfigurement may be accompanied by an extreme anxiety in the patient; and the reverse situation is as frequently encountered, with a patient whose marked disfigurement occasions in him little or no mental distress.

For example, I recently saw two patients whose psychological attitudes contrasted strangely. The first was a young man in his thirties, suffering from pulmonary tuberculosis and epilepsy, whose nose and all four eyelids had been destroyed by burns. Yet in spite of this extensive disfigurement he displayed little, if any, mental distress. His cheerfulness, his sanguine and wholesome attitude were in distinct opposition to that of the second case, a young woman singularly unattractive, with acne scars of the face, who had a burn about a quarter-inch in diameter (heating-pad burn) on the cheek, yet who exhibited deep anxiety over her slight disfigurement, completely ignoring the fact that the burn scar was scarcely discernible among the acne scars.

Just as an objective evaluation of the physical extent or severity of a disfigurement bears no inevitable relationship to the mental suffering that disfigurement occasions, so the other objective social factors which we mentioned above: age, sex, occupation, socio-economic position, cannot be assumed to bear a definite and predictable relationship to the degree of distress felt by the patient. The actress may be less troubled than the housewife, the public figure less than the dishwasher. We can say only that to stand apart from the accepted physical pattern *may be* the cause of anxiety.

Surgical treatment of a disfigurement, therefore, is only half the problem in plastic surgery, of which the psychological treatment is the other half. Two approaches to the patient are equally essential and equally indispensible: the first, an objective consideration of the *defect* and the practicability of remedying it; the second, a consideration of the *patient* and the possibility of achieving a result that will prove satisfying to him. Consideration of the patient involves consideration of his anxiety, needs or motives, the relationship of the total distress to the disfigurement itself, and the rôle of that disfigurement in the patient's general psychological make-up. To direct all one's energy toward one phase of the patient's illness and to disregard the other is comparable to eradicating a malignancy but neglecting the metastasis, or treating the metastasis and ignoring the malignancy.

Frequently a patient's anxiety seems so deep-seated that we classify him as neurotic, as indeed he may be. However, an effort must be made to distinguish between the basic neurotic and the situational neurotic. In the latter type, the personality itself is undistorted, but a neurosis develops

in response to a definite external situation pregnant with conflict. There is no real neurotic personality here, but merely a temporary lack of adaptation to a particular, trying situation. In this type of patient (i.e., with distress or anxiety limited to the disfigurement) the psychological state is the reflection of a definite physical defect and surgical repair will relieve the anxiety just as it will repair the defect.

On the other hand, the result of surgery will be quite different if one is dealing with a basic neurotic personality. Here the patient (for whom the disfigurement may be only a focus for some more basic maladjustment), will, after surgery, quickly find another symptom through which to channel the neurosis. The surgeon who disregards caution and operates upon the basic neurotic will soon find reason to regret having done so. The general surgeon is guided by physical signs; but physical signs alone are not sufficient for the plastic surgeon who must consider a psychic as well as a physical outcome. In my own experience, it may categorically be stated that surgery in the basic neurotic is not effective therapeutically.

Surgical reponsibility in the borderline case which lies midway between the clearly basic and the situational neurosis is not to be ignored nor treated lightly. Just as we have no hesitation in analyzing the patient's blood or in *x*-raying, so we must not be reluctant to investigate his psychological state and, further, to distinguish between the situational and the basic neurosis in the definitely neurotic patient. In general, the patient's history will serve as material for diagnosis, and the specific case may be illuminated by such sample considerations as the following. How did the early family environment account for lack of early security? Is there general emotional instability? Is there lack of social and occupational adjustment? If the defect was acquired and not congenital, what was the patient's emotional status prior to the disfigurement? What effect has the disfigurement had on formation of the patient's present personality?

Finally, in cases in which the patient cannot be completely restored by physical repair, guidance and encouragement leading the patient toward social rehabilitation and toward a normal place in the social world are as essential as is the strictly physical solution.

PLASTIC SURGERY IN CHILDREN

Plastic surgery in the case of the child brings its own attendant problems peculiar to the child patient alone. It is surprising how early distress over a disfigurement, either congenital or acquired, may manifest itself. In this connection it should be pointed out that awareness of the physical defect occurs as soon as the child is capable of realizing a physical distinction between itself and other children: a "difference" which is of course accentuated by the attention focussed upon it by parents, relatives and playmates.

However, awareness of disfigurement may emerge even before the child is capable of comprehending the spoken word, and may have its origin in the undue attention given by others to the disfigurement, often a non-verbal attention which may take the form of excessive handling of the deformed part, or even of facial expression on the part of parent or visitor or nurse. Comprehension outruns speech, and it is not uncommon for me to see children who are unable to speak but who do understand and who will present, for example, a burned or webbed hand for examination without actually being requested to do so.

It might be said that the best treatment is prophylactic, that, in other words, the child should not be exposed to hazards. Here the problem is bound up, in large measure, with the socio-economic setting. The problem of the disfigured child is one of peculiar importance not only to the child himself but to the entire community. For example, the socially underprivileged child must play in unguarded streets rather than in supervised areas. Further, such a child is exposed to many hazards indoors as well as outdoors, for it is subject

to less supervision generally than is the more privileged child.

There are, then, considerations peculiar to the child patient alone and not to the adult patient, as well as elements involved in the treatment of children which are perhaps less significant in the adult than in the child. A child who has, for example, suffered a mutilating injury such as a burn or who, let us say, is injured in the street, has undergone a terrifying as well as a mutilating experience, and is immediately faced with a series of further terrors in a course of treatment which is painful, incomprehensible, bewildering. He is taken to a hospital where he is in the hands of strangers and in an unfamiliar setting. To the actual physical pain which he is suffering are added loneliness and fear. He does not understand what is being done for him, nor to what end the treatment may lead. His inner security is assailed and shaken. It is natural, therefore, that he should act in a defensive manner, fighting back at the doctor or nurse with any weapons at his disposal. He may, for example, find that by screaming and struggling he can evade painful treatment for a time at least. The results of his belligerence and unco-operativeness is either conscious or unconscious neglect on the part of the attendants, or the application of forcible methods to accomplish the treatment. Here again, pain, loneliness and terror enter into the picture. A psychic trauma has from the moment of injury been superimposed upon the physical trauma, and the course of treatment and place of treatment extend both these initial traumas.

In the treatment of physical disfigurement, the surgeon must take all possible precautions to avoid causing, or accentuating, a psychic trauma the effect of which might otherwise persist throughout a lifetime. His approach to an injured or deformed child must be carefully considered. His first effort should be to relieve the pain and quiet the terror. Not only will he repair the physical damage, but he will, to the child too young to be reasoned with, convey a sense of security, calm, relaxation precisely the reverse of that anxiety or fear which parents so often communicate to the child. To the child old enough to understand, the surgeon may adopt an attitude of reason. It has been my experience that in general children are reasonable beings. If, from the very outset, before any additional pain has been inflicted, the surgeon explains in some way what has to be done, the child will usually co-operate. The surgeon must approach this task with tact and sympathy.

Patient understanding, absolute honesty, firmness and great gentleness are essential at all times, and these will in a surprising number of cases bring about helpful co-operation from the child. Along with these general guides to the surgeon's behavior, certain specific technics are helpful. For instance, in the removal of sutures or in doing a dressing that might be painful if the patient were to move, the offer of a small reward of one kind or another will sometimes accomplish wonders. At such a time an obviously playful or absurd remark may change a state of apprehension into one of half-amused toleration of the surgeon's whims, or in any event will provide needed distraction. For instance, an order to the nurse to bring "spinach ice cream" for dinner if the child behaves himself during the dressing, may alleviate tension and markedly facilitate the task at hand. Likewise, engaging the child in some playful argument will serve to distract his attention.

In the course of explanation and of treatment, deceit must never be practiced, either by the surgeon or by any of those others with whom the child comes in contact. For the surgeon must on this score have the co-operation of all who deal with his patient. Of what avail is truthfulness on the surgeon's part if, when a child is to be sent to the operating room, someone else tells him that he is merely going to have an *x*-ray picture taken? The child finds instead that he is taken to the operating room, an ether mask placed over his face, and an anesthetic given. Is it surprising that such a child will struggle and fight

with all his strength against those who, his own reason tells him, are enemies? Or that he will remain resentful, hostile and recalcitrant throughout the course of surgical treatment? The surgeon needs urgently the co-operation of all who deal with the child, and should be quick to avail himself of anyone—nurse, interne, maid, porter—to whom the child may, as children do, take a fancy.

Still another complicating factor peculiar to the treatment of children is the attitude of the parents and here, too, the surgeon must seek co-operation. Too often the deep anxiety of the parents is so readily displayed that a child otherwise unable to comprehend its own situation quickly perceives its parents' attitude and becomes frightened. We mentioned earlier that comprehension outruns speech, and it is surprising how readily the attitude of the parent will communicate itself to the child. Even a child scarcely able to understand the spoken word will comprehend the fear in its mother's face and attitude and detect her mood. There is even a language of muscle tension which conveys the mother's anxiety to the child she holds.

It is inevitable for parents to be continuously in the picture where a child patient is concerned. By their oversolicitude or undersolicitude, by their own fears and half-formed knowledge of what the surgeon is trying to accomplish, by their buried sense of guilt toward a child congenitally deformed or injured through parental carelessness, in short by their attitude both toward the patient and the surgeon, they may do incalculable harm to the morale of the child and render a difficult task immeasurably more difficult. And yet co-operation on the part of the parents is vital in many ways. For example, if it is advisable to delay a reparative operation for some reason, the parents must be impressed with the importance of not directing attention to the disfigurement. And neither parental fear nor guilt nor anxiety must touch the child patient. With the child patient, the plastic surgeon faces a two-fold problem, the psychic as well as the physical trauma; and in dealing with psychic trauma he must have the co-operation alike of patient, parents, and attendants.

SUMMARY AND CONCLUSIONS

Not enough attention has been paid by the surgeon to the psychology of the patient seeking plastic surgery. The plastic surgeon should always endeavor to study the personality of his patient, and in doing so the history and environment should be carefully investigated. It must be borne in mind that the patient's reaction to his disfigurement is an important criterion in the decision as to necessity for correction.

The observations on the adult patient have been made from three standpoints: the objective considerations, i.e., the physical disfigurement itself; the subjective considerations, such as anxiety and related fears; the relation between physical disfigurement and mental distress. In this latter connection, it must be remembered that the disfigurement bears no inevitable proportional relationship to the mental distress it may engender.

The child patient is a special problem and one that requires study and care. The early awareness of physical defect is not generally recognized; and just as the surgeon endeavors to erase all stigmas of physical trauma, so, too, he must continually endeavor to avoid psychic trauma. For what will it avail him if, in repairing the body, he damages the spirit?

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FRACTURES OF THE JAW*

AN ANALYSIS OF 212 CASES

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THE cases reported in this paper were admitted to Kings County Hospital over a period of eighteen months. All patients remained at the hospital for at least twenty-four hours, were treated and if there were no contraindications, discharged and followed in the out-patient clinic.

A review of the literature reveals that there have been previous publications of analyses of fractured jaws. In 1926, Ivy and Curtiss analyzed 100 Cases of Fracture of the Mandible. In 1928, Reiter reported fifty Cases. In 1930, Dean reported fifty Cases. In 1934, Winter reported 200 cases of fracture of the mandible. In 1936, Dunning reported 1,065 cases of fractures of the upper and lower jaw. In 1940, Doherty reported 100 cases of fracture of the mandible. The latter report in a large measure compared with previous statistics and it is the aim of the authors of this paper to bring out certain facts not previously reported and also compare our findings with those of other writers.

Sex and Age. In this group of cases 83.5 per cent of the fractures occurred in the male and 16.5 per cent in the female. It is noticed that this is the highest percentage reported as occurring in the female. The increased incidence may in part be accounted for by the increasing rate of auto accidents during this period.

The youngest patient was a three and a half year old boy and the oldest patient was a seventy-four year old woman. The following table indicates the age group and incidence in our series.

No.	Years	Per Cent
1	10	2.3
11	20	11.7
21	30	35.3
31	40	23.5
41	50	16.3
51	60	7.0
61	70	1.8
71	80	.4
Age not known		1.8
Average age		31.4 years

Etiology. The following table shows the percentage of etiological factors.

	Per Cent
Fist blows	59.4
Industrial accidents	18.3
Auto accidents	16.5
Cause not known	2.8
Following tooth extraction	.9
Miscellaneous	.9
Pathological	.4

The percentage caused by auto accidents is the highest yet reported.

At this hospital, where there are seven surgical specialities, all with separate services, it was not uncommon for many of the cases to be admitted on services other than the Plastic-Oral Surgical Service. Following are the admissions:

	Per Cent
Plastic and oral service	80.6
Neurosurgical service	11.7
O. P. D.	3.7
General surgery	2.3
E. N. T.	1.4

Any patient with questionable head injuries was admitted on the neurosurgical service and worked up completely by them.

* From the Department of Oral and Plastic Surgery, Kings County Hospital.

Then the fractures were treated when that service believed the patient was in condition to have further work done. This accounted in many cases for delay in fixation of the fractured jaw and was a factor in the comparatively large percentage of infected cases.

Associated Injuries. Twenty-five per cent had other injuries, as follows:

	No. of Cases
Lacerations of the face	22
Fractured zygoma	10
Fractured skull	8
Fractured nose	5
Fractured malar bone	4
Fractured humerus	2
Fractured radius	1
Fractured clavicle	1

The twenty-two cases of lacerations of the face all required plastic repair.

Time of Admissions.

55.1% admitted on the day of injury
16.0% admitted on the first day after injury
5.1% admitted on the second day after injury
5.1% admitted on the third day after injury
2.8% admitted on the fourth day after injury
15.5% admitted anywhere from the fifth day to nine months after injury

These figures are significant, especially the large percentage of cases not admitted till after the second day.

Time Elapsing from Injury to Fixation.

28% were treated on the day of injury
23% were treated on the first day after injury
12% were treated on the second day after injury
8% were treated on the third day after injury
4% were treated on the fourth day after injury
25% were treated on the fifth day to the one hundredth day after injury

Again a large percentage of cases did not receive treatment until two or more days following injury.

The period of immobilization was difficult to obtain in many cases therefore, no attempt was made to determine the average period of fixation. Many patients were discharged to private practitioners and the subsequent course was not followed. Some of the patients were not seen at stated follow-ups and all contact with them was lost.

Number of Fractures.

59.9% had one fracture
35.8% had two fractures
3.3% had three fractures
.9% had four fractures

This is the first time that four fractures of one jaw (mandible) has been reported. there were two cases as follows:

(1) Caused by a blow of fist—location of fractures:
  (a) right condyle, (b) left ramus, (c) left molar area, (d) right bicuspid area, patient edentulous
(2) Caused by auto accident—location of fractures:
  (a) bilateral condyles, (b) coronoid process, (c) symphysis; the patient subsequently died from severe sepsis

The following cases had three fractures: (1) bilateral condyles and symphysis; (2) condyle, body of mandible and maxilla; (3) bilateral condyle and symphysis; (4) bilateral condyles and premolar area of mandible; (5) condyle, and bilateral fracture of the body of mandible; (6) symphysis, condyle and coronoid, and (7) maxilla (body) and bilateral fracture of body of mandible.

In six of these cases condylar fractures were present, the association of bilateral condyle and symphysis occurring twice. In two cases, fracture of the maxilla occurred, as contributing one fracture of the three.

Jaw Involved	No. of Cases
Mandible	191
Maxilla	16
Maxilla and mandible	5

Dunning stated that in a series of 1,065 fractured jaws he found the maxilla was fractured three times to every thousand fractured mandibles. It is evident that the incidence of fractured maxillae is much higher in this series. Again the period in which these fractures occurred as compared to those of Dunning (1906–1913) was a time in which the automobile accidents were very much more on the increase as a cause of traumatic injuries of the face.

Types of Fracture	Per Cent
Compound	70.2
Simple	19.3
Compound-comminuted	5.6
Simple-compound	4.2
Pathological	.4

The fact that a large percentage of cases were compound fractures explains many of the complications which occurred.

Location of Fractures. In a series of 212 cases of fractures of the jaws there were 305 separate fractures.

Mandible	No. of Fractures	Maxilla	No. of Fractures
Body	194	Alveolus	11
Condyle	51	Body	7
Angle	10	Unilateral fractures of body	4
Coronoid	6		
Ramus	5		
Alveolus	5		

In the mandible eight patients were edentulous. In the maxilla one patient was edentulous.

Teeth in the Line of Fracture. Ninety-eight patients had teeth in the line of fracture; fifty-five were fractured in the second and third molar areas.

The treatment of these 98 fractures as regards the status of the involved teeth may be subdivided as follows:

A. In 47 per cent (forty-six cases) teeth in the line of fracture were left intact until postfixation period. It was often believed that a molar tooth in the posterior fragment was an excellent means of keeping that fragment in good position even until fibrous union took place. Infection occurred in twenty-eight cases (62 per cent). In this largest group in which teeth were not extracted immediately, the percentage of infection was high.

B. In 27 per cent (twenty-seven cases) teeth were extracted immediately. Infection occurred in six cases (22 per cent); no infection was present in twenty-one cases (78 per cent).

When teeth in the line of fracture were removed, the incidence of infection was less than in the group in which teeth had not been removed.

C. In 26 per cent (twenty-five cases) teeth in the line of fracture were not extracted. Infection occurred in ten cases (40 per cent); no infection was present in fifteen cases (60 per cent). In this group in which teeth were not removed, ten cases or 40 per cent became infected.

It should be stated, however, that in series A the teeth were extracted because of cellulitis, beginning pathological change in the osseous structure at the fracture site, or continued septis.

Osteomyelitis. In 212 cases, 31 per cent developed osteomyelitis; thirty cases had sequestra formation; three had definite osteomyelitis on admission, and thirty-four cases showed soft tissue infection only, with no evidence of any bone involvement. All these cases required external incision and drainage.

Treatment. In all cases, the most simple form of fixation was the treatment. When teeth were present and available intermaxillary wiring was the method of fixation. Ninety per cent were treated in this way.

The nine edentulous cases were cared for as follows: circumferential wiring in six cases; Gunning splint in one case; Barton bandage in one case, and edentulous maxilla fracture, no treatment.

Posterior reduction with use of wire in the posterior fragment and plaster head cap was used in eleven cases. The result in six cases was very unsatisfactory. The most common complications being nonunion, poor position of fragments and infection. This method of fixation has since been discontinued.

A compound block to hold the posterior fragment in position was used in ten cases with good results especially if the block was used immediately before any overriding was present. Interosseous wiring

was used in three cases for non-union with excellent results. The fractured maxillae were treated with the Kingsley splint or the Major appliance if simple interdental wiring was not indicated.

The use of Kirschner wire fixation as suggested by Brown, of St. Louis, was used in one case and since these data were collected we have used it in several more cases with very satisfactory results.

In six of 212 cases the results were very unsatisfactory. Poor approximation of fragments, non-union, and loss of substance (bone) were some of the presenting problems.

When the fracture was promptly treated, and adequate fixation instituted, complications were less.

CONCLUSIONS

1. Data on 212 cases of fractured jaws are submitted.

2. No attempt is made to evaluate the findings presented.

3. Certain facts not previously reported, associated with fractured jaws are analyzed.

4. The increase in the number of fractured jaws is associated with the increase in the number of automobile accidents.

5. The high percentage of fractures in the female is of interest.

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TREATMENT OF FRACTURES WITH THE HAYNES SPLINT*

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IN the treatment of fractures it is desirable to secure good anatomical reduction of the fragments and to maintain such reduction until healing occurs. With fractures of the shafts of the long bones, this is not always easy. Even if anatomical reduction is secured, the prolonged fixation which is usually necessary leads to muscle atrophy, joint stiffness and circulatory impairment. To clear up these secondary changes sometimes requires a greater period of time than that necessary for bone healing. Especially is this true in fractures of the femur. A fractured femur may show firm union in three or four months yet at the end of one year the patient may still have pain, joint stiffness and disability. This prolonged loss of function could be avoided if joint and muscle exercises could be carried out during the healing period. Such exercises are impossible in usual methods of treatment. Obviously a method which permits such exercises while maintaining firm fixation of bone fragments is highly desirable.

The usual methods of treatment of fractures may be divided into four groups: (1) Continuous traction applied to the skin or directly to the bone; (2) external splinting with plaster, metal or wood; (3) internal fixation through an operative incision, using plates, screws, wire or other material at the site of the fracture. (4) skeletal fixation, using external splints applied to pins inserted into the bone.

In the past five years we have treated over two thousand fractures in this hospital. It is not our purpose to present an analysis of this entire group of cases but to discuss some of our experiences with skeletal fixation in fractures of the long bones.

For several years we treated most fractures of the shaft of the femur by open operation using stout vitallium plates or screws. Excellent anatomical reduction was usually secured. The leg was placed in a Thomas splint suspension apparatus following reduction and mild early exercises were encouraged. Results were better than with most other methods but some degree of stiffness, muscle atrophy and circulatory disturbance was common, and bowing or non-union occasionally developed.

A large number of fractures of the shaft of the tibia were also treated by vitallium plating. The incidence of non-union was definitely increased in spite of more perfect reduction of fragments usually achieved by this method. We have, therefore, watched with considerable interest the recent development of skeletal fixation by means of pins and external splints. After comparing various types of apparatus it appeared to us that the one offering the greatest simplicity, strength and applicability was that devised by Dr. H. H. Haynes.[1] We have had the privilege of using this splint in fifty cases and are pleased with the results so far obtained. The fractures treated involved the following bones:

Femur	14
Tibia	16
Tibia and fibula	16
Ulna and radius	1
Humerus	1
Metacarpal	1

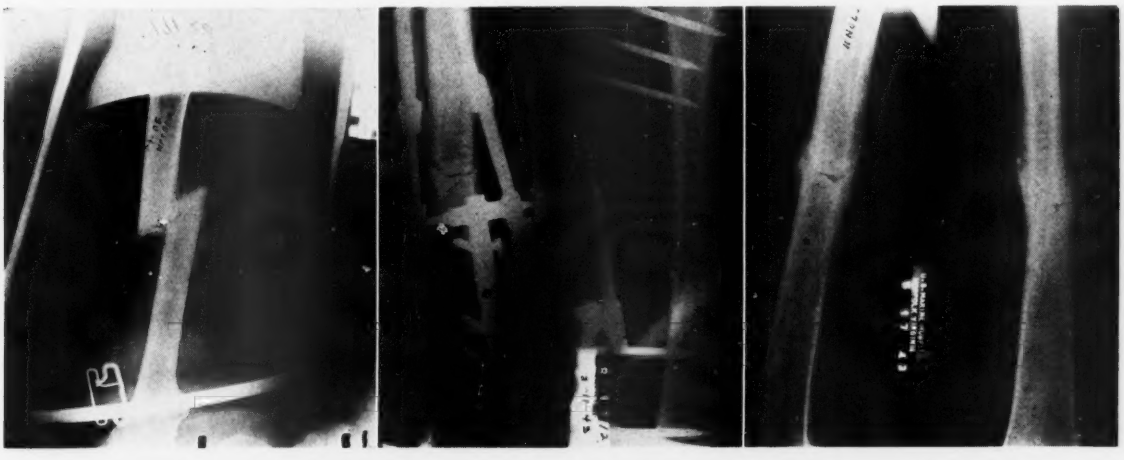
We have also treated one case of tuberculosis of the knee joint by this method of fixation with good results.

The Haynes splint consists of three essential parts: (1) Two or more stout

* From the U. S. Marine Hospital, Norfolk, Virginia.

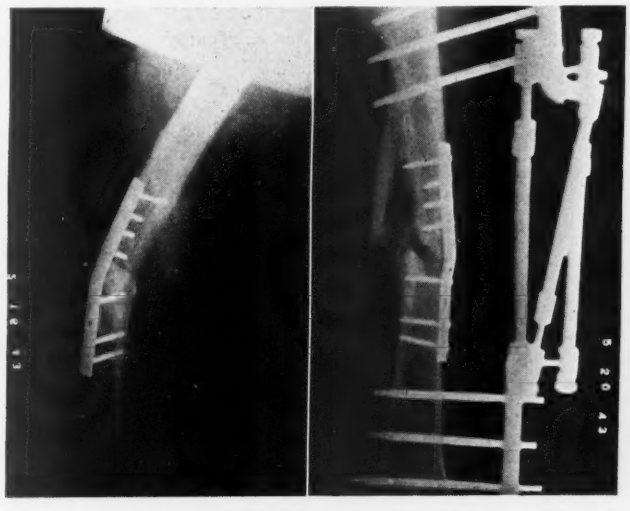
threaded stainless steel pins which have cutting points and are self-tapping; (2) two stainless steel blocks which fit over the pins; (3) two or more connecting bars which are attached to the blocks by friction joints.

In addition there is a reduction frame which permits all ranges of motion necessary to reduction of fragments. The reduction frame is not essential in all cases but it does increase the ease and precision of reduction. In certain fractures, especially of the femur, it may be impossible to secure satisfactory reduction without this equipment.



A B C

FIG. 1. A, B, C, fracture, middle third of femur treated by Haynes Splint. Firm healing, splint removed three and one-half months later. Patient left hospital walking without support under four months from date of injury. This was the first fractured femur treated here by this method.



A B

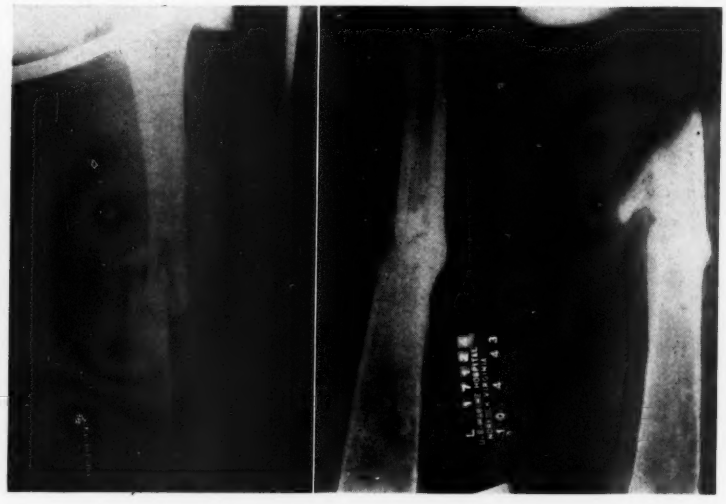
FIG. 2. A, old fracture of the femur treated with vitallium plating. Four months later the femur is badly bowed. B, Haynes splint applied without removing plate and alignment corrected. A pull upward of two hundred pounds are necessary to correct the alignment but the pins did not bend or loosen.

TECHNIC

The application of the splint is comparatively simple. *X*-rays should be made and studied carefully for proper placing of the pins. Under aseptic technic a puncture wound is made in the skin, the muscle and fascia spread with forceps, and

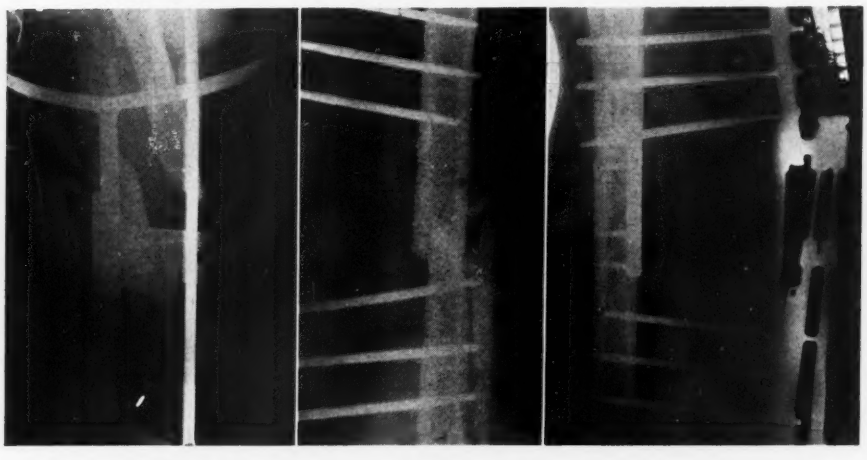
the pin drilled into the bone by the sense of touch. It is desirable that the pin pass through the proximal cortex, and into, but not through the distal cortex. It is not difficult to drill the bone squarely, and it is essential for maximum strength that the pin be drilled through the center of the shaft. Four pins, two above and two below the fracture site, are commonly used in fractures of the tibia, humerus, ulna or radius. In the adult femur an additional pin is used in both the upper and lower fragments.

After the pins are inserted and the blocks are placed over the pins, dressings are applied and sterile technic may be dispensed with. Reduction is carried out under the fluoroscope. The pins will withstand a tremendous strain without becoming loosened or bending. This is well demonstrated in Figure 2. After accurate reduction and while the reduction frame



A B

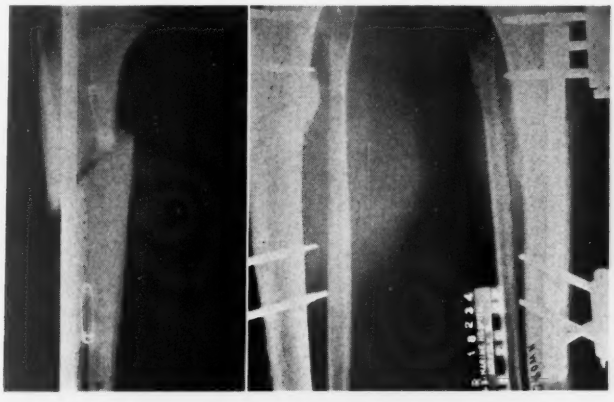
FIG. 3. A, B, fracture of femur treated by Haynes Splint. Although union appeared firm in four months, *x*-ray showed small amount of callus. Splints were therefore left on seven months to guard against accident. No loosening of pins or infection occurred.



A B C

FIG. 4. A, fracture of femur, middle third. B, longitudinal split in both upper and lower fragments not noted on first *x*-ray renders Haynes splint fixation inadequate. C, open reduction and split fragments held in position while pins are drilled through. Small vitallium plate used for additional security. Patient out of bed in three weeks. The splint was removed in three and one-half months at which time firm union was present.

is still in position, the connecting bars are fastened securely. The reduction device is then removed. No fixation other than the splint is required when the patient is returned to bed. Active motion is permitted from the beginning.



A B

Fig. 5. A, fracture, upper third, tibia and fibula treated with Haynes splint. B, approximately three months later with firm union and no joint stiffness; very little muscle atrophy. The splints were removed immediately after the above *x*-rays.

Some of the patients in this group are still undergoing treatment but there have been sufficient recoveries to warrant certain conclusions:

We believe that the healing time is definitely decreased by this method. The patients are more comfortable since they can be up and about instead of being confined to bed. Joint motion is usually possible immediately after reduction. Partial weight-bearing on crutches can be started early in almost all cases. Much harm can be done by creating an impression that patients can walk without support immediately after reduction of a fractured femur or even a tibia. The Haynes splint in our opinion provides the stoutest support now available for skeletal fixation of fractured long bones, but we do believe that a certain amount of caution should be reserved in its use.

Undoubtedly many patients could be up walking the day following reduction, but the same might be said of a patient who had undergone a laparotomy. We have practically always had to restrict patients rather than urge them to greater activity. Nursing care has been cut to a minimum on these patients since they are not long confined to bed, and can take care of themselves with but little help. Their mental outlook is usually good. The profound depression which is so often seen in patients long confined to bed is strikingly absent.

Due to the continuous active use of the limb muscle atrophy occurs only to a very limited degree. Circulatory impairment is slight or absent and there is very little joint stiffness.

The only discomfort of any importance is that caused by skin pull on the pins. This pull is not appreciable in the tibial region but is sometimes troublesome in the thigh. It can be controlled by lessening the patient's activity. The pull of skin and musculotendinous structures against the pins in the thigh at times also cause "pin seepage." This is an irritative rather than an infectious phenomenon and appears to have little clinical importance. The wounds heal promptly when the pins are removed.

There is one point which we would like to stress. During the healing period some absorption takes place in the bone at the fracture site. This factor probably accounts for the increased incidence of non-union where internal plating is used. The same thing may occur with skeletal fixation unless guarded against. The sliding bars on the Haynes splint can be loosened

without changing the alignment of the bone. These bars should be loosened about every ten to fourteen days and the bones slightly impacted. Instead of delayed healing or non-union, more rapid healing will occur than with ordinary methods of treatment, if this point is observed.

In presenting this report based on a limited number of cases, we trust that our enthusiasm has not warped our judgment. It is our carefully considered opinion at this time that the Haynes splint is a valuable contribution to the treatment of fractures of the long bones and that through its proper use healing time is lessened and function improved.

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Dislocations should be reduced immediately, as delay increases the swelling and the continuous pressure of the displaced bone may cause serious damage to the soft parts. In most instances general anesthesia is necessary for muscular relation. For dislocations produced by leverage the displaced bone must be replaced also by leverage, returning through the rupture which it produced in the joint capsule.

From "Fractures and Dislocations for Practitioners," by Edwin O. Geckeler (The Williams & Wilkins Company).

THE USE OF CURARE IN ANESTHESIOLOGY*

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ONE of the most interesting new developments in anesthesiology is the use of curare for obtaining the necessary degree of relaxation. What makes this application of curare especially significant is the fact that this alkoloid is a non-anesthetic and a non-hypnotic drug, thus providing us with a totally different physiological mechanism involved in such an action. Though known since the time of Sir Walter Raleigh and fully described by Claude Bernard in 1865, curare within the last few years only has undergone a transition from an experimental drug of a physiological laboratory to a bona fide clinical agent for the treatment of diseases characterized by convulsive states or by some neuromuscular syndromes such as spastic paraplegia, athetosis and advanced Parkinsonism. The main reason for such a delayed clinical application has been the difficulty, only recently solved, of obtaining a reliable drug of a constant physiological action. Its use in anesthesia is the logical outcome of its application in the convulsive shock therapy of schizophrenia to produce generalized muscular flaccidity in order to protect patients from traumatic fractures.

GENERAL COMMENTS

A proper relaxation is the fundamental requirement for surgery, especially abdominal. Until the appearance of curare it could be achieved only by the depression of the activities of the central nervous system, as is observed in general anesthesia, or by an interference with the nerve conductivity as seen in local analgesia including the subarachnoid block. These methods, though universally employed, have some innate dangers, disadvantages and limitations—a perfect physiological anesthesia as yet does not exist—particularly when in this quest for relaxation the biological bounds of human tolerance for anesthesia are being stretched to the limit. In general anesthesia this usually leads to a profound depression of not only the central nervous system, but also an equal depression of the respiratory and circulatory mechanisms, hypoxia, degenerative changes of parenchymatous organs, loss of electrolytes and so forth, all in a direct proportion to the depth and the duration of anesthesia. Even a local anesthesia has its shortcomings: it is not always applicable, the desired effects even in skilled hands are not always obtainable, not counting the danger from an occasionally encountered susceptibility toward the drug itself or an excessive amount of it. As to spinal analgesia, though capable of inducing an extreme relaxation, this form of local anesthesia has its drawbacks, too, such as a limited time of its duration, an always present danger of an anaphylactic reaction and the inadvisability of this type of analgesia for the aged, especially in the presence of shock.

In addition to these fundamental limitations of present day anesthetic procedures and methods, an anesthetist quite often is faced with certain incidental problems: the anesthesia may be poorly borne by the patient or poorly administered; he may have a patient in whom only a very brief but an extreme relaxation is in order such as is needed in an acute intestinal obstruction or in a difficult bronchoscopy; or a prompt relaxation is imperative for the closure of peritoneum in a patient with a vanishing spinal block. In such cases

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our standard methods may prove to be inadequate.

Curare with its peripheral action on the skeletal muscles only, with its prompt ability to produce perfect relaxation without any direct depression of the central nervous system, and the simplicity of its administration certainly offers us a new weapon to overcome certain difficulties that may arise during anesthesia.

PHARMACOLOGY AND PHYSIOLOGY

Curare is obtained by the brewing of stems, roots, leaves and bark of several species of strychnoes. Its main claim to fame and popularity lies in the fact the South American Indians of the Amazon River and Ecuador have used it as an arrow poison. The active principles of curare are different but related to each other alkaloids of which curarine and tubocurarine are mainly responsible for its specific action. Their chemical composition still remains unknown; in many ways it is related to strychnine. The crude curare is a resinoid mass of a brownish black color, soluble in cold water and diluted alcohol. There are many varieties of curare of which three are the most important, namely, the tubocurare, the calabash curare and the pot curare, deriving their names from the type of the container in which they are sold: bamboo tubes, gourds and earthenware jars. The tubocurare contains two alkaloids: tubocurarine and curine; the calabash curare consists mostly of one alkaloid curarine, while the pot curare contains three alkaloids of which protocurine is the most important. For clinical use curarine and tubocurarine only are suitable; they are very similar in their physiological action and are free, at least in their therapeutic doses, from any damaging effect on the heart and lungs. These two alkaloids are the main source of intocostrin, the commercial preparation of curare which is at the present time on the market. It is a physiologically assayed preparation of a uniform strength and action that comes in a 5 cc. bottle containing 100 mg. of standard drug.

The site of curare's action primarily are the motor end plates or neuromuscular junctions, which make it a peripherally acting agent. Curare does not paralyze either a muscle or its nerve, but exerts a specific action on the chronaxies of the skeletal muscles without affecting the corresponding nerve chronaxies, thus inducing the so-called state of heterochronism. Its blocking of transmission of impulses in autonomic ganglia is not as marked, and under ordinary conditions death from a paralysis of the respiratory muscles takes place before the ganglionic action has time to develop. The muscles of the fingers, toes, eyes, and ears are affected first, then those of limbs, neck and trunk and finally those of the diaphragm. It has no direct action on the heart and consciousness and sensibility are not affected. Curare has no anesthetic properties whatsoever.

The most effective route of administration is the intravenous injection of the drug; the effects of such an administration are manifested very promptly, in one or two minutes. First, there is a feeling of heaviness of the eye lids followed by bilateral ptosis, nistagmus, strabismus and diplopia. The neck muscles are affected next; facial expression is quickly lost, speech becomes difficult due to the flaccidity of the throat and jaw muscles. The spinal muscles are affected next after which a complete paralysis of the arms and legs takes place. The skeletal muscles are affected next practically in the same order as it is observed in progressive myastenia gravis. The choline esthers, physostigmine and prostigmine are the pharmacological antidotes and antagonists to curare due to their stimulating effect on ganglia and skeletal muscles. Gastrointestinal absorbtion of curare is very insignificant in view of a more rapid degree of detoxication than that of absorption. Inasmuch as curare is partially destroyed by the liver and the remainder is eliminated unchanged by the kidneys, a non-impaired function of these organs is essential for the safe administration of this drug. The arrest in

respiration observed after a heavy dose of curare is of a transient character and of no particular danger, at least to the anesthetist, to whom a respiratory arrest such as is obtained in so-called "apnea technic" or "controlled respiration" is not an accident but merely a method for inducing the proper degree of relaxation.

METHOD OF ADMINISTRATION

In view of the unpleasant subjective manifestation following the use of curare, a light general anesthesia, just sufficient to abolish pain sensitivity and consciousness, must be used in conjunction with its administration. Cyclopropane appears to be the most suitable agent. There are two methods for the clinical use of curare: Griffith with his extensive experience with cyclopropane uses a relatively deep cyclopropane anesthesia and one single injection of 100 mg. of intocostrin. Cullen finds such a single injection insufficient, especially if the length of operation exceeds half an hour, and is using additional injections of smaller amounts of curare throughout the operation.

From our rather limited experience we believe that Cullen's method gives a better result. Our technic for the use of curare is as follows: We begin our general anesthesia with cyclopropane and as soon as the first plane of surgical anesthesia has been established the patient is wheeled into the operating room. Simultaneously with the preparation of the operative field one of the patient's arms is exposed and a needle attached to a syringe containing 5 cc. of intocostrin is inserted into the vein. As soon as the skin incision is made 3 cc. of intocostrin are rapidly injected; if the patient is not relaxed by the time the peritoneum is being opened, the remaining 2 cc. of intocostrin are added. As a rule these 100 mg. of curare produce an excellent relaxation usually lasting fifteen to twenty minutes, after which additional doses of 1 cc. of intocostrin are given from time to time depending upon the degree of relaxation needed. Except for the change in the respiration, intocostrin produces practically no systemic effect, the blood pressure and pulse remaining unchanged throughout the operation. One has to be cautious with the secondary injections of curare because of its cumulative action. In one of our cases a rapid injection of 2 cc. of intocostrin near completion of an operation resulted in a severe respiratory depression.

One may ask, what are the advantages of curare in comparison with other rapidly acting agents also capable of producing a complete relaxation, such as the intravenous administration of pentothal sodium. We believe that curare is a relatively safer drug. While with barbiturates the respiratory depression is of a central character and is due to the direct action on the brain, the arrest in respiration that may follow the use of curare is of a secondary character as it is only a sequel to the paralysis of the diaphragm. To combat the latter is much easier than that which is due to a direct central paralysis of respiration.

SUMMARY AND CONCLUSIONS

1. We believe that the use of curare has a definite place in anesthesiology, especially in cases in which a profound but brief relaxation is indicated or in which there are difficulties in obtaining the desirable degree of relaxation.

2. In view of the unpleasant subjective symptoms accompanying the use of this drug, we believe it must be used in conjunction with a light general anesthesia.

3. Unquestionably, curare shall have only a limited application in the field of anesthesiology; but under certain conditions it should prove to be an extremely useful and even a life-saving drug.

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Case Reports

DOUBLE KIDNEY AS A SOURCE OF IMPAIRED DYNAMISM*

ITS SURGICAL TREATMENT BY HEMINEPHRECTOMY

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OF all anomalies of the upper urinary tract, double kidney is the most common. While many different types of this anomaly occur, the one most frequently observed consists of the presence of one large kidney with two independent renal pelves and two ureters. These double ureters may be united at any level, from the lower pole of the kidney to the bladder, or they may open separately into the bladder in the region of the trigone. Sometimes the second ureter is found ectopic, opening at some point outside of the urinary bladder, causing urinary incontinence, particularly in the female, and as a rule producing hydroureter and hydronephrosis in the corresponding half of the double organ. It is also commonly observed that the ectopic ureter corresponds to the upper pole of the double kidney. This duplex condition, when associated with urinary incontinence, always demands surgical intervention for correction of the surgical malformation.[1]

While it is freely admitted that not all double kidneys give rise to symptoms or pathologic conditions, it is a fact that clinically and at postmortem more than half the cases of this congenital malformation are found associated with one type or another of surgical pathologic lesions, some of which demand relief by surgical intervention.

The embryonic development and anatomic varieties of double kidney and ureter have been thoroughly discussed in the literature and will not be gone into at this time.[2]

Although it has been said that three kidneys might be expected to function better than two, clinical experience has shown that such is not the case; and that the third kidney is in most instances an intruder, encroaching upon the rights of the two legitimate kidneys. In other words, it now appears that the supernumerary upper or lower renal pelvis of the double organ may be the source of a pathologic process, discovered urologically or urographically, and that it is present more often than was ever suspected prior to the urographic era.

It has been observed clinically and anatomopathologically that in the double kidney with complete bifurcation of the two ureters there is as a rule a crossing or even a double crossing of these two ureters somewhere between the kidney and the bladder and that the ureter corresponding to the upper renal pelvis is invariably the one in ectopia. Since there is always in these cases a certain degree of nephroptosis, it can be readily understood that the double ureters in crossing make pressure upon one another, and thus interfere with the drainage of the double kidney from which they issue. As a result *the dynamism of these crossed ureters becomes impaired;* their rhythmic contractions are disturbed; the time of emptying is retarded. Owing to the intricate nerve connections between the kidney and ureter on the one hand

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and the chief ganglia of the abdomen on the other, the crises of pain arising in an overfilled ureter and renal pelvis are readily transmitted to the abdominal cavity, where they may give rise to indefinite abdominal pain with nausea and vomiting, frequently mistaken for appendicitis, especially if the double kidney and ureter are on the right side. These abdominal or gastrointestinal symptoms may completely divert the attention from a double kidney as the possible underlying cause of the surgical syndrome, and may thus mislead in diagnosis.

Admittedly, conservative operation for relief of associated disorders in one-half of a double kidney has been performed even prior to the urographic era, but only in cases in which the diagnosis was made at operation. Since urography has been routinely used, conservatism in renal surgery has been steadily on the increase.

FIG. 1. Intravenous urogram revealing the presence of a right double kidney with double pelves and double ureters. The left kidney pelvis is well delineated and appears to be within normal limits. The double ureters of the right side are dilated, demonstrating urinary stasis and dynamic dysfunction.

FIG. 2. Plain roentgenogram showing ureteral catheters and instrument in position. There is no shadow indicative of stone anywhere in the urinary tract. The right ureteral catheter meets obstruction at the level of the last lumbar vertebra. The shadow of the right kidney is enlarged and low in position.

However, it is to be noted that conservative surgery deliberately undertaken for the correction of the *impaired dynamism and faulty mechanics* of the double kidney has been seldom if ever carried out. Usually the double kidney has been left to go on its way, as a harmless malformation of no surgical or pathologic interest, unless a gross pathologic lesion is visualized in the urogram.

The main purpose of this presentation is, accordingly, to discuss this very modern idea of the importance of the *orthopedic surgical correction of the double kidney, with a sole view to its restoration to normal function.*

It is not uncommon to see a patient with a history of abdominal pain who has been operated upon for so-called chronic appendicitis without relief of symptoms, and in whom, after urologic and urographic examination, a double kidney with double ureter in one or both sides of the body is discovered, with evidence of urinary stasis, marked pyelectasis, calyectasis and retardation of the dynamic physiologic emptying time of one or both pelves of the double organ. This double kidney then proves to be the underlying cause of the entire syndrome, and it obviously demands surgical intervention for the correction of the malformation *per se*, with a view to the permanent relief of symptoms for which it is chiefly responsible.

FIG. 3. Right retrograde pyelo-ureterogram disclosing beautifully the presence of a right double kidney with double pelves and double ureters. The double ureters appear to be united into one at the level of the promontory of the sacrum. They are seen to be dilated, revealing urinary stasis and evidence of pyelitis and pyelonehpritis.

FIG. 4. Bilateral retrograde pyelo-ureterogram. The right double kidney with double pelves and double ureters is obviously dilated, disclosing urinary stasis and dynamic dysfunction. The double ureters are crossed, and there seems to be a narrowing at the point of their union. The left kidney pelvis and left ureter are well delineated and within normal limits.

Heminephrectomy, or partial resection of the kidney, has been performed in many congenital malformations of the kidney, notably in the horseshoe kidney and other types of ectopic fused kidney, and even in a single normal kidney with associated pathology in the upper or lower calyx in which double polar resection can be carried out. However, it is my intention here to discuss only the applicability of this conservative operation to the orthopedic restoration of the dynamism and correct

function of the double kidney with double ureter. I am referring to the group of cases in which the presence of the double organ has caused persistent crises of indefinite abdominal pain, without visualization of gross pathologic conditions, cases in which many errors of diagnosis have been made, including those in which an unavailing appendectomy has already been performed, and in which the patient, after being properly diagnosed urologically and urographically, has at long last been submitted to an operation planned and successfully carried out solely for such functional restoration, with conservation of renal tissue, achieving permanent cure with disappearance of all symptoms.

To this end I am reporting an illustrative case with completely satisfactory results, and I am presenting at the same time the technic that I have successfully employed.

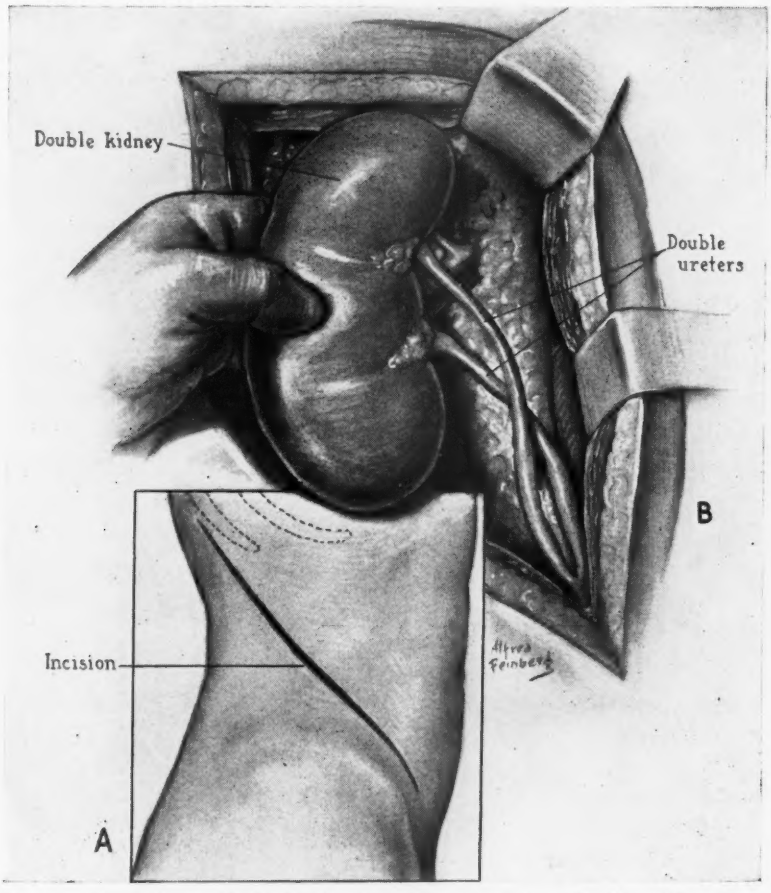

Fig. 5. Operative technic for heminephrectomy in a double kidney: A, drawing of oblique lumbo-abdominal incision; B, the double kidney and double ureters are readily exposed and drawn out of the wound. The double ureters are seen dilated, crossed and united into one at the level of the sacro-iliac synchrondrosis.

ILLUSTRATIVE CASE OF A RIGHT DOUBLE KIDNEY WITH DOUBLE URETER CAUSING INDEFINITE ABDOMINAL PAIN AND URINARY DISTURBANCES FROM BIRTH—CURED BY HEMINEPHRECTOMY

Miss F. T., twenty-four years of age, an office secretary, was referred to me October 7, 1941, complaining of pain in the right lumbar region, frequency of urination day and night, and marked dysuria. She gave a history of having had an attack of pain on the right side of the abdomen for which she was operated upon about a year ago and an appendectomy carried out, but without relief of symptoms.

Attacks of this kind were repeated on several occasions after the appendectomy operation, and incapacitated her for work. About three weeks previous to coming to the office she awoke with another such attack which kept her in bed for several weeks, during which time she stated that she had been taking sulfa drugs without relief of symptoms. From her parents I then learned that when the child was three years old she had begun to have these attacks off and on, and had suffered frequently ever since with gas pains, chronic constipation and marked abdominal distention. The voided specimen of urine was cloudy and contained pus and traces of albumen.

On physical examination the abdomen was distended, and the scar of the appendectomy operation in the lower median line of the abdomen was clearly observed. The right kidney was enlarged on palpation, low in position, tender and easily palpable. The left kidney could not be palpated. Examination of the external genitals was normal. Rectal examination was negative. The impression was of right nephroptosis with definite disturbance in the right kidney, for which a complete urologic and urographic examination was carried out.

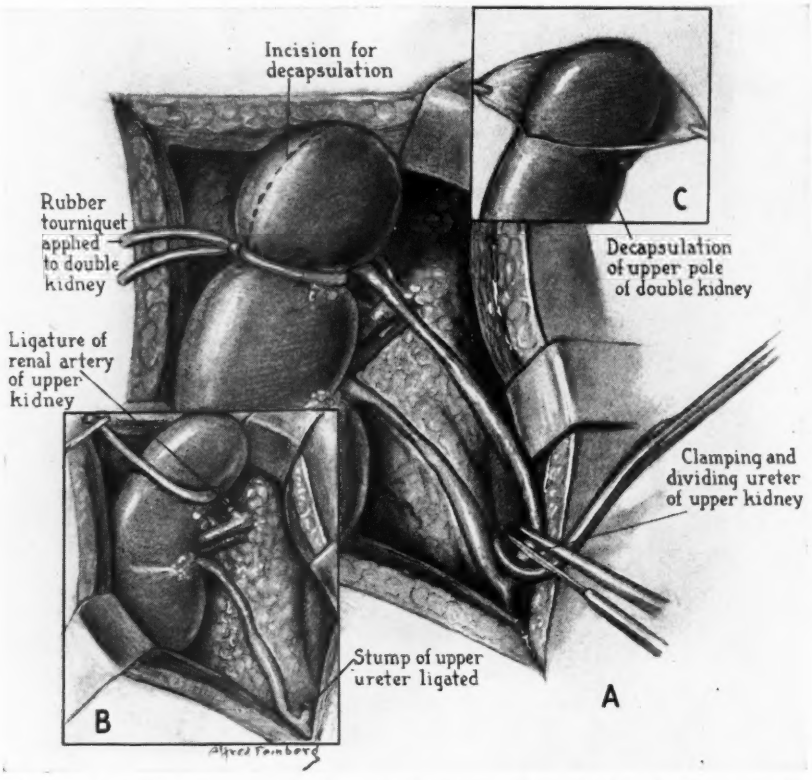
Incision for decapsulation
Rubber tourniquet applied to double kidney
Ligature of renal artery of upper kidney
Stump of upper ureter ligated
Clamping and dividing ureter of upper kidney
Decapsulation of upper pole of double kidney
A
B
C

Fig. 6. Operative technic for heminephrectomy in a double kidney: A, the ureter corresponding to the upper kidney pelvis is doubly clamped at its junction with the ureter corresponding to the lower kidney pelvis, and divided and ligated. A rubber tourniquet is applied around the line of demarcation between the two parts of the double kidney to serve as a landmark for their separation and for better hemostasis. B, the stump of the divided upper ureter is dissected free in order to visualize the pedicle of the kidney and the blood supply of the upper pole of the double organ. The retropyelic renal artery of the upper kidney, which was here a branch of the main renal artery, is exposed, clamped, excised and ligated. C, the capsule of the upper pole is incised longitudinally, freely separated and retracted to expose the renal parenchyma.

Intravenous urograms disclosed the presence of a right double kidney with double ureters, with pyelitis and pyelonephritis and evidence of pyelectasis, calyectasis and lack of drainage. In fact the ninety-minute film disclosed marked retardation of the emptying time of the double kidney and double ureters. (Fig. 1.) The left kidney was clearly visualized and within

normal limits. In view of these findings retrograde studies were carried out, including cystoscopy, catheterization of ureters, differ-

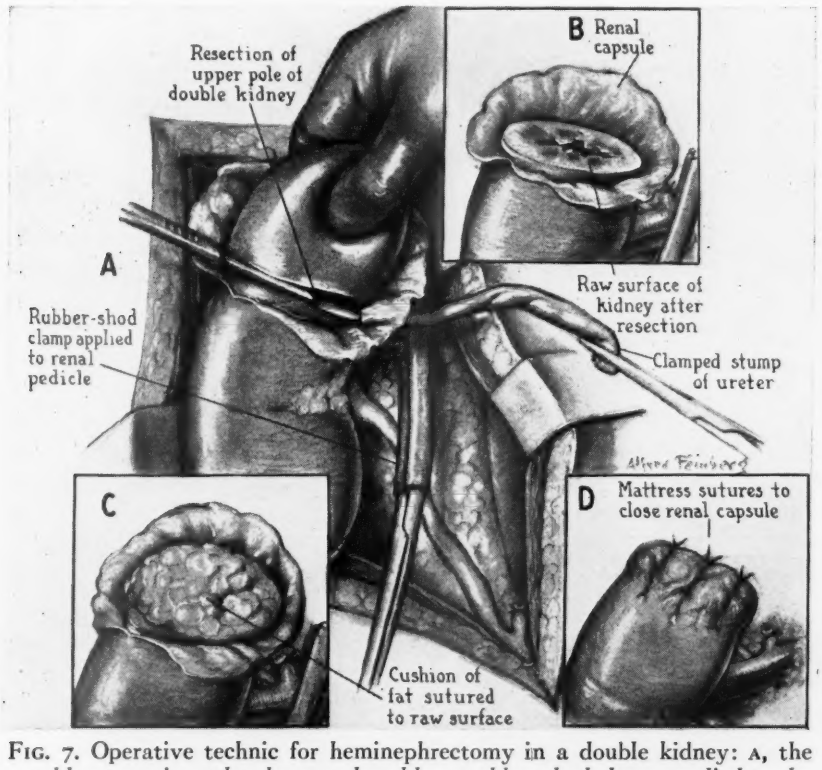
Resection of upper pole of double kidney
B Renal capsule
A
Rubber-shod clamp applied to renal pedicle
Raw surface of kidney after resection
Clamped stump of ureter
C
D Mattress sutures to close renal capsule
Cushion of fat sutured to raw surface

Fig. 7. Operative technic for heminephrectomy in a double kidney: A, the rubber tourniquet has been replaced by a rubber-shod clamp applied to the pedicle for better anatomic exposure and complete hemostasis. The upper pole of the decapsulated double kidney is resected with its entire upper ureter. B, the raw cut surface of the kidney after resection is seen with the retracted renal capsule. C, a cushion of fat is transplanted to cover the raw surface of the kidney to prevent bleeding and is fixed in position with plain catgut sutures. D, the capsule of the remaining portion of the resected double kidney, which is already covered with the cushion of fat, is drawn together and closed with mattress sutures.

ential renal functional tests and bilateral retrograde pyelo-ureterograms to determine the separate function of the three kidneys, and also to discover whether the two ureters of the fused organ opened normally into the bladder or were united outside of the bladder. A specimen was sent to the laboratory for culture, urea estimation and microscopic examination.

The retrograde studies, carried out on October 16th, revealed beautifully in the film of the right pyelo-ureterogram the presence of a double kidney with double renal pelvis and ureters (Figs. 3 and 4), the latter crossing each other at the level of the fourth lumbar vertebra and interfering with the dynamism and emptying time of both right renal pelves. The two ureters were united at the level of the right sacro-iliac synchondrosis to continue as a single ureter which opened normally into the bladder. There was also mechanical obstruction at the point of their union, more marked in the pyelograms taken in the erect posture, thereby revealing also a certain degree of nephroptosis. There was dilatation of the calyces and both pelves and ureters throughout, indicating the presence of urinary stasis, pyelitis, pyelonephritis and marked ureterectasis. The upper pelvis of the double kidney was T-shaped, while the lower one appeared to be that of a fairly normal kidney pelvis. The two right renal pelves were definitely separated from one another and were clearly without intercommunication.

The impression, therefore, was that of a double kidney on the right side with duplication of renal pelves and ureters, with evidence of marked urinary stasis, nephroptosis, lack of drainage and obstruction at the union of the two ureters, all these combining to cause

dynamic dysfunction, responsible for the entire syndrome.

The patient was accordingly admitted to the Murray Hill Hospital October 16, 1941, for operation on a double kidney. It was explained to her that the lack of dynamism and the faulty drainage were the cause of all her troubles and that these no doubt would continue to cause a gastro-enterorenal syndrome, which could be permanently cured only by carrying out a heminephro-ureterectomy under general anesthesia.

Operation was performed on October 18, 1941, under cyclopropane anesthesia. With the patient lying on her left side, an oblique incision about 15 inches long was made running obliquely downward from the right costovertebral angle through McBurney's point to the midline. (Fig. 5A.) Fascia and muscle were cut and retracted; bleeding points were clamped and ligated; the peritoneum was retracted. The fatty capsule of the kidney was clamped and opened from behind; the kidney, which was somewhat adherent, was freely exposed and liberated from its surrounding attachments by blunt dissection. Its two ureters, running to the two separate kidney pelves, were identified and exposed down to the point where they united at the level of the sacro-iliac synchondrosis. (Fig. 5B.) The ureter corresponding to the upper kidney pelvis was clamped at its junction with the ureter corresponding to the lower pelvis. (Fig. 6A.) The upper ureter was excised, its stump cauterized with carbolic acid and alcohol, and then ligated with chromic catgut. The double kidney was then properly exposed out of the wound and the pedicle dissected from behind to identify the blood supply of the organ. By retracting the cut ureter of the upper kidney pelvis and by blunt dissection, the retropyelic renal artery of the upper kidney, which was a branch of the main renal artery, was exposed, clamped, excised and ligated. (Fig. 6B.) A rubber-shod clamp was applied to the pedicle of the kidney to prevent bleeding and to obtain better exposure. A soft rubber catheter was tied around the kidney as a tourniquet in between the two renal pelves and about the line of demarcation between the two parts of the double kidney. (Fig. 6A.) The capsule of the upper pole was incised and dissected from its attachment to the kidney, thus accomplishing its decapsulation. (Fig. 6C.) The upper kidney was then excised and removed, with its attached ureter, leaving the retracted capsule. (Fig. 7A and B.) There was practically no bleeding, but a piece of fat was transplanted to the raw surface and held in place by several transrenal sutures of catgut; this raw surface with its covering of fat was

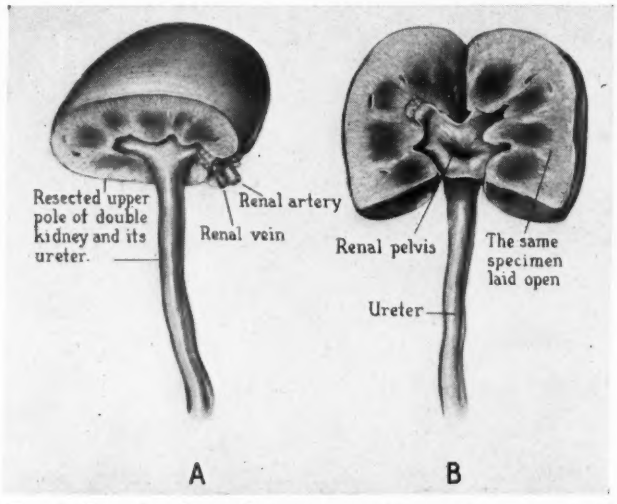

FIG. 8. Drawing from the postoperative specimen removed at operation: A, the heminephrectomized upper pole of the double kidney is shown with its pelvis and ureter, and its corresponding renal artery and renal vein. B, the same specimen laid open, showing a dilated renal pelvis and ureter, and revealing normal parenchyma with pyelitis and pyelonephritis.

then covered over with the renal capsule, which was closed with mattress sutures. (Fig. 7C and D.) The rubber-shod clamp on the pedicle was removed, and again there was no bleeding, hemostasis being complete. Nephropexy of the remaining organ was then carried out by simple fixation with chromic catgut sutures between the levels of the eleventh and twelfth ribs, suspending the organ in its normal position. This procedure puts the ureter in a perfectly straight line and secures good drainage. The kidney was further anchored by placing another suture in the capsule of the lower pole, fixing it to the quadratus lumbaris muscle to complete the nephropexy. Gerota's fatty capsule was closed from below, right up to the quadratus lumbaris muscle and over the kidney up to the costovertebral angle, as a further reinforcement of the nephropexy. A cigaret drain was placed in the upper angle of the wound; the wound was closed in layers by chromic catgut sutures, first the muscles, then the fascia, and finally the skin with silkworm gut sutures.

Postoperatively the diagnosis was double kidneys with double ureters on the right side. The two ureters were doubly crossed, and there was definite stricture at the point where they united, interfering with normal drainage, with evidence of dilatation of both ureters, acute pyelitis and pyelonephritis. The specimen consisted of the upper pole of the resected double kidney with its dilated pelvis and ureter. (Fig. 8A and B.)

The patient had an uneventful convalescence and left the hospital twenty-five days after the operation with the wound completely healed and free from symptoms.

Three weeks after operation, in order to check up the results, I carried out complete studies, including cystoscopy, catheterization of both ureters, differential functional tests and bilateral retrograde pyelo-ureterograms. The results of these various tests proved that the remaining portion of the right double kidney, which had been heminephrectomized, was functionally and urographically perfectly normal. (Figs. 9, 10 and 11.) In fact the function of this kidney was better than that of the left kidney with reference to phenolsulphonephthalein and urea excretion, thus indicating that the remaining half of the double right kidney will be sufficient to sustain life.

COMMENT

I am reporting this case because it illustrates so beautifully the rôle that the

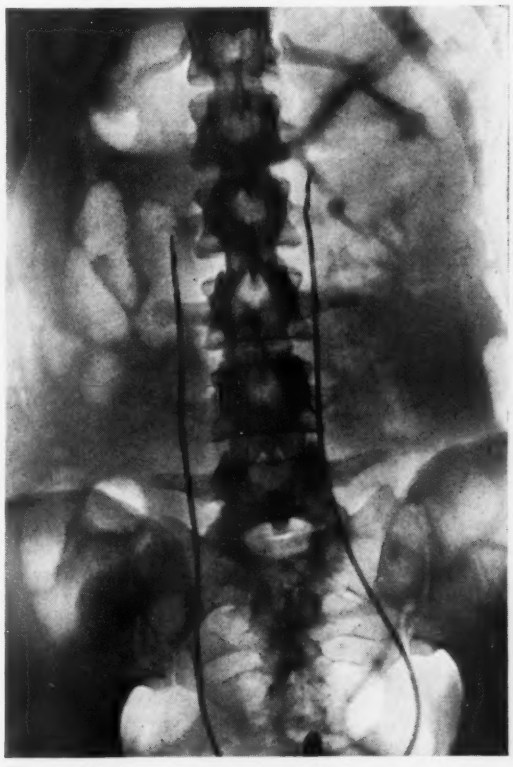

FIG. 9. Plain roentgenogram of the same patient taken three weeks after heminephrectomy of the right double kidney. Note the correct position of the two ureteral catheters and especially the one in the right ureter, which before operation could not be catheterized.

anomalous double kidney can play in the causation of surgical disorder in the upper urinary tract. It serves also to show how easily the general surgeon can overlook the true cause of symptoms that masquerade as acute conditions of the abdomen, when in reality they originate in the urinary system.

Here was a girl who had suffered from birth with intermittent attacks of indefinite abdominal pain, often hovering about McBurney's point, so that the case was easily mistaken for appendicitis and an unnecessary appendectomy performed without relief of symptoms. When the true cause was discovered in a double kidney with double ureter, with congenital dysfunction leading to chronic urinary stasis,

it was obvious that treatment must be addressed to the surgical correction of the malformation. As soon as this was done, relief of symptoms promptly followed, with complete restoration of normal function and disappearance of symptoms.

Fig. 10. Right retrograde pyelo-ureterogram taken three weeks after right heminephro-ureterectomy in a double kidney followed by nephropexy. Note that there is now only one renal pelvis, which is the lower pole of the resected double kidney. The major and minor calyces are well delineated and appear normal. The ureterogram discloses a perfect right ureter with good drainage. The kidney has been restored to its normal position and function.

Fig. 11. Bilateral retrograde pyelo-ureterogram in the same patient three weeks after operation. The right kidney pelvis, calyces and ureter are within normal limits urographically and functionally regarding urea excretion and phthalein elimination. The left pyelo-ureterogram also reveals a left pelvis and ureter within normal limits. The patient is free from symptoms after right heminephro-ureterectomy for adynamic double kidney.

It is important to understand what the mechanics of the emptying of a double kidney is. Inasmuch as this anomalous kidney is usually in a certain degree of nephroptosis, and the two ureters, crossing one another, are always anatomically adherent to the parietal peritoneum, which they continually traumatize, it is inevitable that each ureter will interfere with the drainage of the other by interrupting its normal physiological peristaltic contractions. This will naturally cause retention in both pelves of the double organ, producing pyelectasis, calyectasis and dilatation of the ureters. Urinary stasis results from this interference with the dynamism of the kidney, with the result that a small hydronephrosis is formed, accompanied by crises of pain. The partial retention of urine in the pelvis of the kidney and in its two ureters not only produces chronic pyelitis, pyelonephritis and pyelo-ureteritis but also acts as a constant insult to the parietal peritoneum, which is responsible for the attacks of abdominal pain with nausea and vomiting, simulating those observed in appendicitis. The dynamics of the physiologic emptying of the renal pelvis is interfered with and the emptying time retarded, due to the faulty mechanics of the double organ and its double ureters. This interference leads in the course of

time to further disturbance, with a tendency to the complete destruction of the renal parenchyma if the malformation is not surgically corrected.

The delayed urograms taken one or more hours after intravenous injection of the opaque substance show clearly this delay in emptying time of the organ, and disclose the actual condition present. The retardation indicates the impaired dynamism of the organ, which in my case was clearly revealed in the ninety-minute film, both renal pelves and both ureters of the double kidney being still distended with the opaque substance (Fig. 1), whereas in the normal kidney the physiological emptying time is from five to fifteen minutes.

The conservative surgical treatment of double kidney with a gross pathologic lesion, visualized in the urograms, has been amply discussed in the literature and need not be stressed at this time. Operations for heminephrectomy and partial resection of the kidney in cases of this type have been performed from the time of Albarran,[3] Tuffier,[4] Paoli,[5] Czerny[6] and other surgeons of the pre-urographic era. More recently this conservative operation for relief of associated gross pathologic lesions in the double kidney has been carried out by Legueu,[7] Papin,[8] Young,[9] Eisendrath,[10] Kretschmer,[11] Goldstein and Abeshouse,[12] Hess,[13] Campbell,[14] Gutierrez[15,16,17] and a host of others. In fact many cases have now been reported in the literature in which heminephrectomy has been done in a double kidney, but only when it has been associated with a gross lesion urographically revealed.

These, however, are not the type of case with which I am concerned in this presentation. All these authors were dealing with gross pathologic conditions, such as stone, cyst, large hydronephrosis, pyonephrosis, tuberculosis and even tumor in one-half of the double organ, all of which frankly demanded surgical intervention. In the group of cases of double kidney in which I am here interested, there is, on the contrary, no gross conditions visualized in the urogram. However, the delayed intravenous urograms will give a hint of what we are dealing with, and the retrograde pyelograms taken with the patient in the erect position will actually disclose the nature of the condition, which consists in the *faulty dynamism of a double kidney*, which is responsible for mechanical failure of the double organ to empty properly and results in the gastro-enterorenal syndrome. This condition can definitely be relieved and cured by a conservative heminephrectomy or hemi-ureteronephrectomy, as in the case here reported.

This type of operation is simple, since there is always a good line of demarcation between the two halves of the double kidney, and each half has an independent blood supply. (Fig. 6B.) The fear of bleeding during the resection of the kidney is groundless, since proper ligature of the blood supply is easily made and the raw surface of the resected kidney can readily be covered with fat to prevent hemorrhage. (Fig. 7C.) In the case here reported there was no bleeding whatsoever. As the two pelves of the double organ are entirely independent of each other, there is no danger of urinary fistula. Even if a calyx has to be resected, it can be sutured properly to prevent leakage. The operation should always be followed by a nephropexy to secure good drainage from the remaining single ureter of the heminephrectomized kidney.

In the group of cases in which there is a history of a previous abdominal operation without relief of symptoms, no other type of conservative operation seems so rational as a heminephrectomy or hemi-ureteronephrectomy, since it gives assurance of a permanent cure. Other conservative procedures that have been envisaged for double kidney and ureter, particularly in cases of hydro-ureter and hydronephrosis, include pelvio-ureteral anastomosis, anastomosis of the two ureters at any level, transplantation of ureters into the bowel or into another portion of the bladder,

simple nephropexy and even denervation or decapsulation of the kidney. But none of these conservative procedures seems to offer promising results. Some cases of ureteral anastomosis have completely failed to correct the dynamic dysfunction and have come finally to a secondary nephrectomy.

The technic of heminephrectomy and hemi-ureteronephrectomy is as simple as that of lumbar nephrectomy and should be carried out, since it has the advantages not only of correcting the malformation and overcoming the painful symptoms, but also of conserving renal tissue and securing normal renal function.

SUMMARY AND CONCLUSIONS

1. Double kidney with double ureter is the commonest of all congenital malformations of the upper urinary tract, and when accidentally found demands a complete urologic and urographic examination.

2. The double kidney with bifurcation of ureters is a potential source of dynamic dysfunction of the urinary system, resulting not only in painful urinary symptoms but also in repeated crises of abdominal pain.

3. These recurring attacks of abdominal pain with gastrointestinal symptoms are due to the constant insult inflicted upon the parietal peritoneum by the adynamic double kidney and its crossed double ureters.

4. The anomaly of the double kidney *per se*, without association of visualized gross pathologic lesions in the organ, is responsible for these painful symptoms.

5. Every patient suffering from repeated attacks of indefinite abdominal pain should be submitted routinely to urologic studies, especially when the pain is on the right side, in order to rule out an anomalous surgical condition of the kidney.

6. When the physiologic emptying is retarded or incomplete in one or both pelves of the duplex organ, there is always evidence of a surgical condition.

7. Delayed urograms taken one or more hours after intravenous injection of the opaque substance are of great value in diagnosis, but an adynamic condition thus revealed should always be confirmed by retrograde pyelographic studies.

8. Heminephrectomy or partial resection of the double kidney with the corresponding supernumerary ureter appears to be the operative procedure of choice, offering the best prospect of restoration of function and complete disappearance of symptoms.

9. Heminephrectomy is as simple an operation to carry out as an ordinary lumbar nephrectomy.

10. The technic of heminephrectomy for correction of a double kidney is described in detail and graphically illustrated.

11. This conservative surgical procedure should be followed by nephropexy to straighten the ureter and secure good drainage from the remaining half of the double organ.

12. Conservation of tissue in renal surgery is imperative whenever feasible.

13. Patients submitted to this orthopedic correction of the double kidney should have a complete urologic and urographic postoperative check-up to confirm the anatomic and functional results before leaving the hospital.

14. When the double kidney is urographically discovered and is associated with painful symptoms and dynamic dysfunction, the condition should always be considered surgical even in a so-called "normal double kidney."

15. An illustrative case is reported to demonstrate the practical applicability and the excellent results of heminephrectomy in adynamic double kidney.

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When intranasal tuberculosis extends to the nasal bone or nasal process of the maxilla, it causes necrosis, cold abscess, and fistulization of the cutaneous structure.

From "Tuberculosis of the Ear, Nose, and Throat," by Mervin C. Myerson (Charles C. Thomas).

MESENTERIC THROMBOSIS*

CASE REPORT

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THE occurrence of mesenteric thrombosis is infrequent enough to warrant a report of our case and a brief review of the pertinent literature. Hertzler and Wangensteen report the prognosis as universally grave. However, in the case to be discussed uneventful recovery followed operation.

CASE REPORT

Mrs. M. M., a thirty-six-year-old white female, entered the hospital August 15, 1943, with a history of acute abdominal pain of two days' duration, generalized over both lower abdominal quadrants. This was accompanied by chills, fever, and vomiting, but no diarrhea. No bowel movement had occurred during this time. An oil enema given on admission was returned with no results.

Past history was essentially irrelevant except for an appendectomy thirteen years ago and a cesarean section five months previous to admission.

Physical examination revealed an apprehensive patient with a temperature of 96°F., pulse 130 and thready, and respirations 30 and shallow. Blood pressure on admission was 210/100 but rapidly fell to 80/50. The skin became cold and clammy and the patient went into shock. The abdomen was distended, rigid, and tender to palpation; however, no tumor was present. On percussion, dullness was evident particularly over the flanks.

Urinalysis showed a clear specimen with a 1.021 specific gravity, three plus albumin, three plus sugar, and two plus acetone. Microscopically, two to three red blood cells and two to five white blood cells per field with many hyaline casts were seen. Examination of the blood gave evidence of hemoconcentration with a hemoglobin of 130 per cent (Salhi), red blood count of 6,500,000 and a white count of 34,600. Differential count showed 93 per cent polymorphonuclear leukocytes and 7 per cent lymphocytes. A tentative diagnosis of intestinal obstruction was made.

Immediate shock treatment was instituted and 250 cc. of blood plasma were given intravenously followed by 1,000 cc. of 5 per cent glucose in normal saline. As soon as the shock was relieved, a laparotomy was done under nitrous oxide and ethylene anesthesia. On entering the peritoneal cavity, a large quantity of bloody fluid was found. A segment of ileum four feet in length, (middle part of ileum) was found to be hemorrhagic, edematous, and dilated; the color was a dark purple. Hot abdominal packs applied to the dilated segment failed to produce any change in its color. The portion of the mesentery anchoring the involved part of the ileum was hemorrhagic and revealed thrombosis throughout the secondary arcade of veins, while a constricting band was found at the base of the mesentery. During the operation, 500 cc. of blood and 500 cc. of normal saline were given, together with 10 minims of neosynephrine to maintain the blood pressure. The involved portion of the intestine was resected and a side-to-side anastomosis done. During the operation, blood pressure fluctuated from 90/70 to 130/90, but the patient's condition improved immediately after the operation when a second blood transfusion was given.

Postoperative treatment consisted in giving 1,000 cc. of 5 per cent glucose and normal saline every eight hours and gastric (Wangensteen) suction to prevent abdominal distention. The temperature remained at 100°F. for one week after which it returned to normal. The postoperative course was complicated by the appearance of a focal nephritis the first day after operation, when the blood pressure rose to 190/100 and urinalysis gave a specific gravity of 1.022, three plus albumin, 100 red blood cells per field, and many coarse granular casts. The urinary output was about 1,100 cc. in twenty-four hours. This picture gradually

* From the Surgical Service of Dr. Thorvald Petersen, Fairview Hospital, Minneapolis, Minnesota.

improved and by the eighth day postoperatively the blood pressure returned to normal and the urine was clear. The patient was discharged on the twenty-first postoperative day.

COMMENTS

Occlusion of the mesenteric veins is more commonly seen today than in the past because it is diagnosed earlier. It occurs more frequently in males than in females in a ratio of two to one.[1] It prevails during the fifth decade of life and although rare in infants and old individuals, Laufmann and Scheinberg[1] report cases in infants of ten days and in patients of eighty years. The site of the thrombosis varies and may occur in the portal vein or any of its tributaries. In a series of twenty-five cases of mesenteric thrombosis Laufmann and Scheinberg[1] found fifteen cases of portal vein occlusion, eight cases of superior mesenteric and only two cases of inferior mesenteric vein occlusions. Wangensteen[2] quoting Trotter (1913) finds that mesenteric thrombosis occurs in 40 per cent and mesenteric embolism in 60 per cent of cases of mesenteric occlusion.

The history of mesenteric thrombosis dates back to Tiedemann who reported the first case in 1842. Virchow was the first to describe its pathological picture and reported one case in 1847. The first operation was performed by Elliot in 1895. Jackson, Porter, and Quinby in 1904 revealed 214 cases reported up to that time while Moore,[3] in 1941, reviewed the literature and added eight cases of his own. According to Bell[4] about 770 cases of occlusion of the mesenteric vessels both arterial and venous have been collected up to 1940.

The etiology of mesenteric thrombosis has been fairly well established and five main factors are believed to be responsible. They are: (1) peripheral sepsis, (2) portal obstruction, (3) mechanical obstruction, (4) blood dyscrasies and (5) trauma. Cokkinis[5] believes the first to be the more frequent cause. Infection may reach the mesenteric veins from any of the organs drained by their branches. Portal obstruction may be caused by pressure on the wall of the vein or cirrhosis of the liver. Blood dyscrasies such as polycythemia rubra, and leukemia are contributing factors. It also appears that abdominal operations play a definite rôle in causing mesenteric thrombosis. Injury to the mesentery or mesenteric veins during operations and the formation of postoperative adhesions appear to be the most important mechanical means by which thrombosis is initiated. Badin[6] reported a case of appendiceal abscess and extensive inflammation of the mesentery with thrombosis of the mesenteric vein supplying the distal 10 cm. of the ileum. Macroscopically, the intestines show patches of dark blue discoloration which becomes more progressive and assumes the appearance of generalized congestion of the intestinal wall. Red infarction gradually develops with hemorrhaging into the lumen of the intestine and bloody fluids extravasates into the peritoneal cavity. The extent of the lesion may vary from an area of several centimeters in length to all of the small and half of the large bowel. However, many cases occur in which portal occlusion alone is present without involvement of any of the large or small intestine. Moore[3] states that vascular disturbance does not always leave permanent structural changes. When the blood supply to the bowel is slowly cut off, there may be no symptoms of occlusion during life and little abnormality of the intestine at autopsy.

The clinical picture of mesenteric thrombosis depends upon the extent of involvement of the mesentery and the intestine. The degree of vascular occlusion and the rapidity of spread probably account for the occurrence of acute and chronic cases of venous thrombosis. In chronic cases, a history of intermittent low abdominal pain, paroxysmal in nature, coming on after meals, and not showing any definite localizations is usually observed. Acute cases usually develop severe colicky abdominal pain, very sudden in onset, which

is followed by vomiting and shock. Bell[4] states that chronic cases show a 50 per cent spontaneous recovery. Wangensteen[2] remarks that many cases of mesenteric thrombosis run a fairly mild course, a week often elapsing before an abdominal lesion is suspected. Intestinal obstruction occurs in only a few cases of venous thrombosis. Vomiting is often overshadowed by pain according to Fallis[7] while the reverse is true in obstruction of the small intestine. Vomiting in some cases may relieve the pain. Constipation is often present and the presence of blood on rectal examination confirms the diagnosis. Bloody diarrhea may be present depending upon the extent of hemorrhagic necrosis. The differential diagnosis should include hemorrhagic pancreatitis, acute cholecystitis, perforated peptic ulcer, and acute intestinal obstruction.

Immediate operation is the treatment of choice and the prognosis in most cases is directly proportional to the time elapsing before intervention. The mortality rate is very high, approximately 84 per cent in an operated series of nineteen cases by Whittaker and Pemberton. It can be reduced only by earlier diagnosis and prompt operative intervention. Exteriorization of the involved section is inadequate and invariably leads to peritonitis. A lateral anastomosis should be done while small localized lesions may be left unoperated.

SUMMARY

The case of venous mesenteric thrombosis is reported and the pertinent literature reviewed. An evaluation of the symptoms of mesenteric thrombosis is offered and an attempt made to clarify the diagnosis. Early surgical intervention is emphasized. The case reported was interesting because of successful operation with recovery and because of the occurrence of a complicating renal picture developing the first day after operation.

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CALCIFICATION OF THE PANCREAS

CASE REPORT

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PANCREATIC lithiasis is a relatively rare pathological condition. It was first described by Regner DeGraff in 1667. The most recent summary of literature by Haggard and Kirtley in May, 1932, reported only 204 cases during a period of 271 years. Of these 204 cases, 139 were non-operative and sixty-five were operative. However, since this review of literature appeared there have been numerous case reports. Among those who have had case reports since Haggard are: Moss and Fries, two cases; Stanford and Byrnes, one case; Faust and Brandstett, one case; Moulten, one case; Rockwern and Snively, two cases; Winnett and Caldwell, one case; Poppel and Levy, three cases; Thomason, four cases; Townsend, three cases; Snell and Comfort, eighteen cases. This would bring the totally reported number of cases, including the one herein reported, to 241 cases.

There are two distinct types of pancreatic stones: (1) those in which true pancreatic stones are found in the pancreatic ducts, corresponding to stones in the gall ducts or ureters; (2) false stone or calcification of the gland in which the stones are found chiefly in the parenchyma, and less often in the ducts. This case is of the second type. This second type of calcification of the pancreas is much rarer according to King and Waghelstein, who reported four cases of their own in 1942 with only eleven other cases in the literature.

The stones may vary in number from one to several hundred and are usually very hard of a greyish white cast and resemble salivary calculi. Those that have been examined were found to be composed of calcium carbonate and calcium phosphate. They are found in all parts of the gland substance and are found in the ducts of Wirsung and Santorini, and also

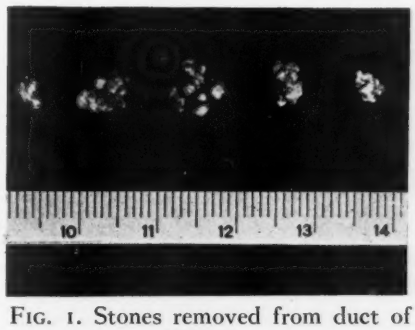

FIG. 1. Stones removed from duct of Wirsung.

in cysts and in ectatic cavities. However, they are most commonly found in the duct of Wirsung in the head of the gland.

Etiology. The exact manner of formation of pancreatic stones is somewhat in question. One theory is that the formation is similar to gallstones, that is due to obstruction of the flow of pancreatic secretion with resulting pancreatic stasis and infection in the ducts. The fact, however, that they are usually composed of calcium carbonate and calcium phosphate, which is not found in this form in normal pancreatic secretion has been altered by an inflammatory process with resulting deposition of calculi within the ducts, and this second theory would seem to apply rather than the other in the case herein described.

Symptomatology. The clinical symptoms of the condition are varied and unreliable, and this accounts in part for the rarity with which the clinical diagnosis of the condition is made. The most important symptom is pain. This may range from attacks of obscure epigastric pain to

severe colic resembling gallstone colic. This epigastric pain radiates often to the back or shoulders and often to the left side and into the left costal vertebral angle. Nausea and vomiting are often present in the acute attacks. In cases in which there is considerable pancreatic damage, symptoms include fatty stools, loss of weight and diabetes mellitus. Jaundice is not a particularly characteristic symptom, although in many cases a history of jaundice at some time or another is often present. The main condition with which this may be confused is with cholelithiasis. The pain in pancreatic stone is often nearer the midline and this is a most important aid in diagnosis, but the only positive way in which a diagnosis can be made is through the use of *x*-ray. Pancreatic stones are easily demonstrated by *x*-ray as they cast a denser shadow than gallstones. Scattered throughout the gland, their location is very typical. Although present in the plate they are often overlooked as they were in this case.

The treatment of pancreatic stones is surgical removal. In cases of diffuse calcification of the gland as here described, it is obviously impossible to remove all the stones. However, the results from removing the stones from the duct which were causing acute colic as in this case are good. The removal of obstructive stones in this instance resulted in amelioration of symptoms. The results of operation in general have been rather satisfactory and the mortality rate is not excessive. The operative approach depends upon the location of the stones. The most common approach is through the gastrocolic omentum into the lesser peritoneal cavity. Others make the incision in the mesocolon and still others expose the pancreas through the gastrohepatic omentum. The latter approach was used in this case. Pancreatic fistula or digestion of the wound edges or pancreatitis

FIG. 2. Postoperative *x*-ray; anteroposterior view showing calcified areas in pancreas.

has not proved common following surgery. The number of operative cases now stands at about seventy-five or eighty with a mortality of about 10 per cent. Following surgery the medical treatment should consist of dietary measures, use of hydrochloric acid for elimination of calcium salts as advocated by Loebar, and the use of pancreatin as in the case of chronic pancreatitis. Early diagnosis followed by appropriate treatment before destruction of the pancreatic tissues has occurred can best be achieved by bearing the possibility of this condition in mind, and by the use of the flat roentgenographic plate in all gastrointestinal examinations.

CASE REPORT

The patient, G. L. S., age thirty-nine, a white male, was admitted to St. Jerome Hospital, Batavia, New York, on September 16, 1942, at 4:15 P.M. with a complaint of abdominal pain and vomiting. His past history was as follows: In November, 1929, he was operated upon at St. Jerome Hospital for a fracture of the patella sustained in an automobile accident. Following this he remained in good health. During the years 1932, 1933 and part of 1934 he drank excessively, but in the latter part of 1934 or in early 1935 he stopped drinking entirely. His first symptoms referable to the gastrointestinal tract began during 1936, and were dyspeptic symptoms. He complained of indigestion and discomfort or distress in the epigastrium, but did not have much gas or any severe pain. During the following year he lost about twenty pounds and began to notice a loosening of the bowels. About this time he began to receive medical attention. In 1938, he had a severe attack of jaundice, lasting about six weeks. During 1939 and 1940, he began to have infrequent attacks of moderately severe epigastric pain and continued to lose weight. During 1940, he had a severe attack of pain which disabled him for about ten days. Every three or four weeks he would have an attack of pain and gas, which lasted for a day or two. In December 1941, he had a gastrointestinal series which was pronounced negative for gallstones or ulcers. At this time the pancreatic calcification was observed but was misinterpreted as probably being due to stomach powder in the intestinal tract. This fact was found out after operation. In 1941 and 1942, the patient dieted and took antacids and stomach powders, but the attacks increased in

FIG. 3. Postoperative *x*-ray taken in oblique view to throw shadow in head of pancreas away from spine; shows well the impossibility of complete surgical removal.

severity until the time of admission to the hospital.

On admission to the hospital the patient complained of epigastric pain and slight tenderness in the right lower quadrant. His temperature was 98.8°F., pulse 88, respiration 20, white blood count was 16,850, urine was negative for sugar or albumin, specific gravity 1.022, hydrogen ion concentration 7.0 microscopically negative. A diagnosis of probable acute appendicitis was made and in view of the long gastrointestinal history it was decided to do an exploratory operation at the same time. Ether anesthesia was used, and a right paramedian incision was made. The appendix, which was moderately inflamed, was removed. The upper abdomen was then explored and a hard crepitant area was found. This was thought to be stones in the gallbladder, but on extending the incision the gallbladder was found to be normal and the hard crepitant mass was still palpable higher in the epigastrium. Upon further extending the incision this area was found to lie above the lesser curvature of the stomach and to be a calcification or lithiasis of the pancreas. Incision was made through the gastrohepatic omentum, exposing a hard,

greyish calcification. An incision was made upon this calcification which released a small amount of fluid and the stone was removed. It was found to lie in the duct of Wirsung, which was probed about 1½ inches in each direction and three or four other stones were removed. This seemed all that could be done although there were many other calcifications present. After removing a small section of tissue of the incision, the pancreas was sutured with chromic catgut and the abdomen was closed in layers with two cigarette drains to the region of the pancreas.

The pathological reports were as follows: Specimen: An appendix 6 cm. long, to 7 mm. wide. The wall was not strikingly thickened. The lumen contained light brown inspissated firm fecal matter.

Microscopic: The lumen of the appendix was obstructed and distended by inspissated fecal matter. The mucosa showed a number of small scars containing rather many eosinophilic leucocytes. The lymphatic tissue was markedly reduced in some areas. The remaining follicles showed large secondary follicles.

Diagnosis: Obstruction and scars within the mucosa; no evidence of purulent inflammation or tuberculosis.

Specimen: Four calculi with corrugated, greyish to light brown surfaces, having a

FIG. 4.

FIG. 5.

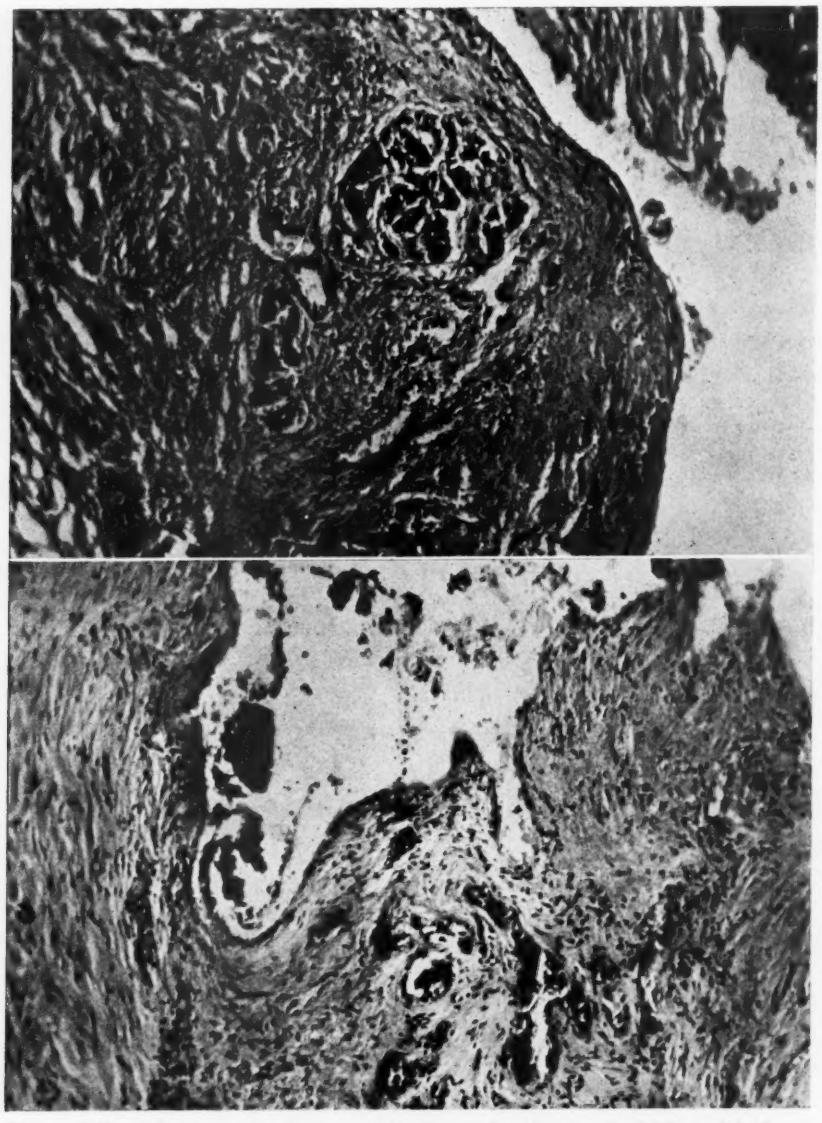

FIG. 4. Microphotograph of pancreatic tissue showing typical islet with dense fibrous tissue and considerable round cell infiltration.

FIG. 5. Microphotograph of pancreatic tissue showing dense fibrous tissue and large duct filled with calcareous matter.

diameter from 2 to 3 mm. and a mass of soft tissue measuring 12 : 3 : 3 mm. On cross section this appeared to be a segment of a duct-like structure which held embedded another small calculus 2 : 2 : 1.5 mm. in size.

Microscopic: Sections showed that the soft tissue was composed mainly of dense fibrous scar tissue that included many small arteries and nerves and some comparatively large hollow spaces which were compatible with small pancreatic ducts. Their epithelium was mostly shed off and replaced by small superficial round cell infiltrates but, here and there, especially in small folds or sinuses a columnar epithelium was seen for a certain distance. One of these ducts showed a distended segment, sinus-like, filled with calcareous matter. Within the scar tissue several fragments of glandular lobules were observed, one showing definitely the architecture of a Langerhans islet.

Diagnosis: Pancreatic calculi located in small ducts, the surrounding pancreatic tissue having been replaced by fibrous scar tissue; no evidence of tumor or malignancy.

Postoperatively the patient did very well, the most annoying complication being a rather persistant cough. One drainage tube was removed on the fifth postoperative day and the other on the ninth postoperative day. The patient was discharged on the eleventh postoperative day. He returned to his home and was getting along very nicely for about two weeks when he had a severe abdominal pain with marked distention of the abdomen and was readmitted to the hospital. He remained there for three days and the pain was relieved promptly by morphine and cathartics. Following this episode the patient's recovery was one of progressive improvement and after three months he returned to work as a defense worker. At the present time he is better than he has been in some time and has very little indigestion or gas, although he watches his diet carefully and takes glutamic acid and pancreatin three times a day. Unfortunately, he has developed a postoperative hernia for which he wears a support. This gives him very little in the way of symptoms.

CONCLUSIONS

1. Pancreatic lithiasis and pancreatic calcification are relatively rare.

2. The cause of calcification and formation of stones of the pancreas is somewhat obscure.

3. The symptomatology is not clean cut and often resembles cholelithiasis.

4. In the acute cases the colicky pain in the epigastrium and radiating to the left back is the most characteristic feature.

5. In long standing cases with destruction of pancreatic tissue, loss of weight, steatorrhea and diabetes mellitus may occur.

6. The positive diagnosis can be made only roentgenographically.

7. Treatment is surgical.

8. An operative case still under observation is reported.

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EARLY POSTOPERATIVE MECHANICAL INTESTINAL OBSTRUCTION FOLLOWING THE REMOVAL OF A RUPTURED, GANGRENOUS APPENDIX*

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IT is generally recognized that the diagnosis of mechanical intestinal obstruction in the early postoperative period following the removal of a ruptured, gangrenous appendix is difficult. A clear-cut picture is not often seen, and keen clinical judgment is necessary to make the diagnosis.

It was decided to investigate all the deaths resulting from such mechanical obstruction during the period from 1936 to 1943, in order to determine methods by which the diagnosis of mechanical obstruction in the postoperative period might be made, and how it might be distinguished from paralytic ileus due to a diffuse peritonitis. There were seven such cases.

CASE REPORTS

CASE I. F. S., four years of age, was operated upon April 16, 1943. A gangrenous, ruptured appendix was removed, and thick purulent material was found free in the peritoneal cavity. Sulfanilamide powder and three rubber drains were inserted. The temperature was 104.6°F. (rectal). The abdomen was distended, but not rigid, and continued to be so the following day, when the temperature dropped to 101°F. (rectal), following the use of intravenous salt solution. Treatment consisted of continuous Wangensteen drainage, intravenous fluids, sulfonamide solution, and blood transfusions. *On the third postoperative day* the abdomen was soft and distended, gas was passed per rectum, and peristalsis was heard. The temperature ranged from 100°F. to 101°F. (rectal). On the fifth day the drains were removed. A milk and molasses enema and hypodermic prostigmin were given. Gas and feces were expelled. However, the abdomen remained markedly distended and tense. On the sixth day the temperature rose to 104°F. (rectal). A few râles were heard at the lung bases. On the same day the patient expired.

At autopsy the small bowel was markedly distended down to a point one foot from the cecum. At that point organizing purulent exudate was found kinking the bowel. Distal to this point the intestinal tract was collapsed. The adhesions were easily broken, and the continuity of the lumen re-established. No other exudate was seen. The lungs showed atelectasis and interstitial round cell infiltration microscopically.

CASE II. W. G., fifty-six years of age, was operated upon on May 5, 1943, and a ruptured appendix was removed. Free pus was seen in the abdominal cavity. Two drains and sulfanilamide powder were placed in the abdomen. The temperature at this time was 101°F. There was no change in the patient's condition the following day. On the second postoperative day the abdomen was described as distended. There were several bouts of vomiting. Wangensteen drainage was used for several hours. Prostigmin was given hypodermically without effect. *On the third day* the drains were removed. The abdomen was still distended. Peristalsis was not heard. The temperature at this time was 99.4°F. On the fourth day the abdomen was more distended, tense, and somewhat tender. A small semi-solid stool followed the use of an enema. The temperature remained down until the sixth day when it rose to 102°F. The abdomen became more distended, vomiting was frequent, and the patient soon succumbed.

At autopsy organizing exudate was seen obstructing the small bowel about three feet from the cecum. The intestines proximal were distended and filled with liquid and gas. The bowel distal was collapsed. No other free exudate was seen. Microscopy revealed a minimal

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bronchopneumonia and moderate atelectasis of the lung bases.

Case III. S. W., sixteen years of age, was operated upon in January, 1938, and a ruptured appendix was removed. Free pus was found in the peritoneal cavity, and three drains were inserted. The temperature was 101.6°F. On the first postoperative day the abdomen was described as distended and somewhat tender. The patient vomited several times. Wangensteen drainage was used for the next twenty-four hours. The temperature was 101°F. The following day the symptoms continued, but fluids were allowed by mouth. The temperature fell to 99°F. *On the third postoperative day* distention became severe. Peristalsis was heard. An enema and prostigmin were ineffective. The temperature at this time was 98.6°F. Distention progressed the following day. Turpentine stupes and pitressin were again ineffective. There was no change, and the temperature remained normal until the eighth day, when it rose to 101°F. The drains were shortened on the tenth day. Due to the progressive distention it was decided to use the Miller-Abbott tube for decompression on the thirteenth day, but the patient expired soon after.

At autopsy a collection of organizing pus was found involving a loop of small bowel about six and one-half feet from the ileocecal junction. The proximal bowel was markedly distended. No other peritoneal reaction was seen.

Case IV. E. T., thirty years of age, was admitted on September 26, 1936, with a diagnosis of acute pelvic inflammatory disease of two days' duration. No operation was performed. The temperature on admission was 101.4°F. The following day the abdomen was slightly tender, but peristalsis was heard. An enema was given without effect. The temperature remained the same. On the second day (corresponding to a postoperative day in the other cases) the abdomen became more distended, and the patient vomited several times. The temperature ranged on that day from 99.6°F. to 101.4°F. The patient had a liquid bowel movement and passed some gas. *On the third day* the abdomen was even more distended. Peristalsis was barely audible, but the temperature fell to 98.6°F., and remained so for two days (third and fourth days). On the seventh day peristalsis was heard, but the abdomen remained distended. The temperature did not exceed 100.6°F. On the eighth day the patient developed a sharp pain in the left leg. The temperature rose to 103.6°F. The abdomen remained distended and was now tender. An enema resulted only in the passing of a small amount of flatus. The patient died the same day.

At autopsy a perforated, gangrenous appendix was found. There was a localized peritonitis in the right lower quadrant surround loops of small bowel. The intestinal tract proximal to this point was distended. There was no bowel gangrene. There was an early terminal bronchopneumonia microscopically.

Case V. R. S., fourteen years of age, was operated upon for a ruptured, gangrenous appendix on February 18, 1939. The temperature on admission was 99.4°F. Free pus was found in the peritoneal cavity, and three Penrose drains were introduced. On the first post-operative day the abdomen was slightly distended. No gas or feces was passed. The temperature remained the same. The following day distention continued, and the temperature dropped to 98.6°F. *On the third postoperative day* the patient passed gas per rectum, although the abdomen remained distended, and peristalsis was not heard. On the evening of the same day the patient complained of severe pain in the left leg. The following morning the temperature rose to 103.8°F. From then until death on the seventeenth day the temperature fluctuated between 99.4°F. and 105°F., the phlebitis became worse, abscesses of the leg developed, and terminally a Staphylococcus aureus septicemia resulted. During the entire course the abdomen was markedly distended. Distention failed to respond to enemas or stupes. No stools were passed. Peristalsis was heard on several occasions. Wangensteen drainage was used intermittently.

At autopsy a localized collection of organizing exudate was found in the right lower quadrant. A loop of small bowel was trapped in the exudate. The bowel proximal was markedly distended. Although death here was largely due to the septicemia, the distention probably played some part. The true nature of the ileus was not recognized before death.

Case VI. A. M., fifty-seven years of age, was operated upon March 20, 1938, and a ruptured appendix was removed. Free pus was seen in the peritoneal cavity, and several drains were introduced. The temperature on admission was 103°F. On the following day the abdo-

men was distended and tender. Peristalsis was heard. No flatus was passed. The temperature fluctuated at this time from 100°F. to 101.4°F. *On the third postoperative day* the temperature dropped to 98°F. The abdomen was more distended. Peristalsis was barely audible. Some gas was passed spontaneously the following day. The patient expired on the fifth day. The highest temperature was on the evening of the fourth day, when it reached 100.6°F. There was no bowel movement at any time.

At autopsy exudate was found only in the right lower quadrant where it was obstructing a loop of small bowel. There was distention proximal to the obstruction.

Case vii. A. U., forty-seven years of age, was operated upon August 16, 1937, and a ruptured appendix and free pus were found. The appendix was removed, and two drains were inserted. The temperature on admission was 102.4°F. On the first postoperative day the patient was allowed sips of water, but this was promptly vomited. On the second day the patient complained of "gas pains." The abdomen was distended. No peristalsis was heard. Pitressin was given hypodermically without effect. No gas or feces was passed. These symptoms continued until the fourth day when the distention became severe. Six hundred cc. of fluid were removed from the stomach by tube. The patient died the same day. The temperature on the second postoperative day varied from 98.4°F. to 100°F.; *on the third day*, from 98°F. to 99°F.; on the fourth day it rose suddenly to 103°F., when the patient expired.

At autopsy organizing exudate was seen in the right lower quadrant. A loop of small bowel was obstructed at this point. The bowel proximal was distended. The bowel distal was collapsed. No other peritoneal reaction was seen.

All the patients were seen and operated upon the second day following the onset of symptoms. In all the pulse rates varied with the temperature. When distention became severe, the respiratory rate usually rose out of proportion to the temperature. In only three cases were white blood cell counts done repeatedly. In all of these there was a drop from at least 13,000 cells per cubic millimeter with 92 per cent neutrophiles to under 9,000 cells per cubic millimeter with a normal differential on the fourth day. After this time the counts were somewhat elevated.

COMMENTS

While the diagnosis of small intestinal obstruction due to adhesive bands occurring weeks or years after operation is easily made, the recognition of mechanical obstruction in the immediate postoperative period is usually difficult. In addition, when free pus is discovered at operation for a ruptured appendix, the obstruction that develops is often attributed to a paralytic ileus associated with a diffuse peritonitis. It must be appreciated, however, that the body resistance often overcomes the general infection, localizing it, and that the organization of such collections of purulent material is capable of involving and obstructing the bowel. The incidence of local peritonitis following ruptured appendices varies in different reports. Penberthy et al.[15] report 183 of 1,653 cases of appendicitis, with only one death. At autopsy gangrene of the small intestine due to an adhesive band was found. W. E. Ladd, in a discussion of the same paper, reports seventy-five cases of ruptured appendices treated with chemotherapy, in which there was a death due to intestinal obstruction and sepsis. Stillman[17] found 124 cases of ruptured appendices in which thirteen developed acute ileus. Obstruction in twelve of the thirteen was found in the small intestine, and all were due to adhesions. In thirty-four cases of acute ileus complicating acute appendicitis with abscess or diffuse peritonitis, Van Beuren[18] reports that the mortality was 56 per cent of which 47 per cent (of the 56 per cent) were due to mechanical ileus. It must be appreciated that acute ileus of the mechanical type can produce death. Miller,[11] in a study of 343 surgical cases of intestinal obstruction, found that the mortality increases the longer the obstruction exists. If ileus is present for more than ninety-six hours, the mortality reaches 84 per cent. The mechanism of death is as yet unknown. Some believe that

even in diffuse peritonitis with ileus, distention is the important factor.[15] Others believe it is due to toxic absorption from the peritoneal cavity. Still others claim that hypochloremia subsequent to vomiting is the important factor. It may well be that all these play some part.[1] In cases of mechanical obstruction absorption from the peritoneal cavity is not present, but a combination of the other factors may still be active.

In an analysis of the cases presented in this report it is worthy to note that none was suspected of having mechanical ileus. The following features were present in all cases: First, the temperature, elevated early, gradually subsided until the third postoperative day, when in no case was there a temperature over 100°F. orally (or 101°F. rectally), and in most the temperature was between 98.6°F. and 99.6°F. Second, after the fourth postoperative day the temperature rose again until death several days later (except in the case complicated by phlebitis and Staphylococcus aureus septicemia, in which case the temperature was due to the infection). Third, distention started soon after operation, was progressive, and failed to respond to stupes, prostigimin, or pitressin. Only one patient had abdominal pain as a prominent symptom. Most of the patients had bowel movements and passed flatus almost to the day of death.

It appears that only on the third and fourth postoperative days is the temperature down in all the cases while distention is present. Before the third, and after the fourth day, the temperature is often quite elevated, and the picture of a diffuse peritonitis with ileus is stimulated. This picture is recognized as consisting of an elevated temperature, abdominal distention, and toxicity. Four cases of diffuse peritonitis with paralytic ileus following ruptured appendicitis were found in the postmortem records. In these the temperature fluctuated from 99°F. to 104°F. from the first day to the end. At no time was there any stabilization of the temperature below 100°F. for forty-eight hours. The abdomen in all was distended, and feeble peristalsis was heard in two cases. Consequently, the third postoperative day is the critical one in differentiating the two types of ileus. It is reasonable, I believe, to assume that before the third day the temperature is elevated since there is some degree of diffuse peritoneal irritation still present, and the body is attempting to localize it. When the inflammation is localized, the temperature falls to low levels. After this time the progressive abdominal distention, already present for a few days, is responsible for the gradually climbing temperature curve. Abdominal distention on the first two postoperative days may occur following any abdominal operation. However, it responds well to ordinary measures employed. In order to be significant, the distention should be progressive and persist beyond the third day.

The prognosis, of course, varies for the two types of ileus. Much more can be done for the mechanical type early. We must recall that if mechanical ileus persists too long, the mortality rises. Early recognition and active treatment (operative or medical decompression) are necessary.

SUMMARY

1. Seven deaths associated with mechanical ileus in the early postoperative period following the removal of ruptured appendices are presented.

2. A low temperature (under 100°F. orally) on the third postoperative day, in the presence of persistent abdominal distention, with or without peristalsis, is indicative of a mechanical, rather than a paralytic obstruction.

3. The presence or absence of bowel movements is unreliable as an aid in diagnosis.

4. Early recognition and treatment will lower the high mortality rate of unrelieved mechanical obstruction.

Since the completion of this paper, I have had the opportunity to see a number of cases,

all of which fitted into the clinical picture described. In each instance the diagnosis of mechanical obstruction was made and proved correct by either operation or the rapid improvement following intensive medical therapy. Since we are more adept in differentiating beginning mechanical obstruction from diffuse peritonitis, and confident in our conclusion, we do not hesitate to give large, repeated doses of parenteral prostigmine and pitressin quite early (third postoperative day), with the hope of breaking any early adhesions. We have been definitely successful with this program, and have had to operate on only one patient in whom the obstruction persisted. At operation well organized adhesions were found in the right lower quadrant of the abdomen. I believe it is a safe procedure to persist with medical treatment for twenty-four hours. If there is no improvement in this period, it is best to operate before distention becomes severe.

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DISASTROUS SEQUELAE TO THE WEBSTER-BALDY OPERATION

CASE REPORT

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REPORTS of disastrous sequelae to the Webster-Baldy operation for retroversion of the uterus are appearing with increasing frequency in medical literature.

Its technic was developed at the turn of the century and was reported by Webster in 1901,[23] and Baldy[2] in 1903. The latter reviewed his experience with it in 1909[3] and each reported again in 1915,[4,24] at which time Baldy gave Andrews credit for having been the first to perform this operation.

While both men emphasized its use for only carefully selected cases, and Webster described in detail steps to prevent adhesions to raw surfaces or hernia through the broad ligament opening, neither reported a postoperative complication.

Richardson[18] reported the first disaster in 1920. For the twenty-three years since then, fourteen others have been found in the literature. The following seems to be the sixteenth case to be presented.

CASE REPORT

The patient was a forty-five-year old, well controlled diabetic. As she strained to open a window, there was sudden onset of a mild pain in the lower left side. This continued and was soon accompanied by nausea and occasional vomiting.

The early hours of this episode were not unlike many such spells during the past twelve years. As these were frequently associated with the menses, she had been under treatment for dysmenorrhea and proceeded to follow her usual routine of bed rest, heating pad and mild sedation.

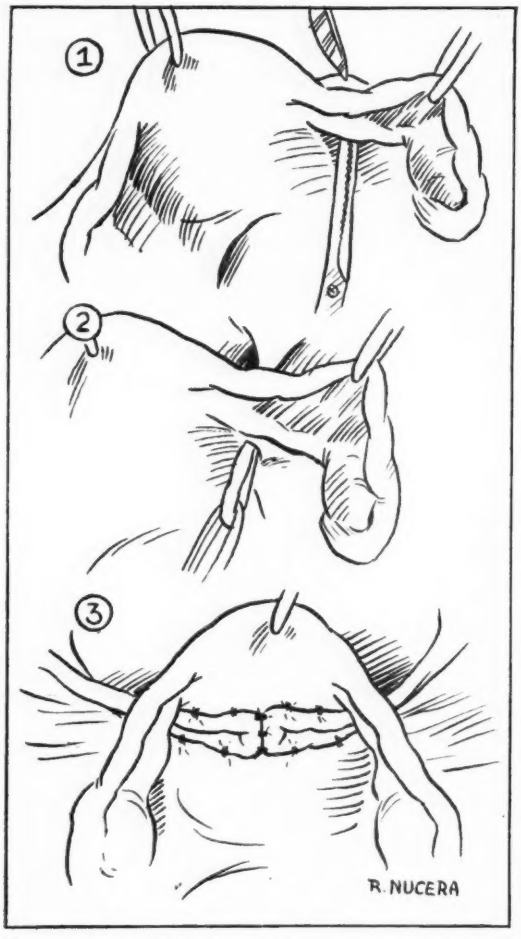
The nausea persisted with occasional retching, and the pain increased in severity, spreading toward the epigastrium. After several hours, the patient became pale and cold, her pulse slow and weak. She was obviously acutely ill and was admitted to St. Johns Hospital, Yonkers, New York.

On further examination the temperature was 99.6°F., the pulse 60, regular but weak, respiration, 16; blood pressure, 100/60; skin, cold and damp. The abdomen moved freely with respiration and was not distended. Peristalsis was present and seemed normal. No masses were palpated but there was definite tenderness in the left lower quadrant. Vaginal examination revealed the presence of a fluctuant mass in the left fornix. This was moderately tender but too soft to be outlined. The leucocyte count was 19,600 with 93 per cent polymorphonuclear cells. Urinalysis was negative. Diabetes as a causative factor was quickly ruled out.

The patient's prostration was out of all proportion to the clinical findings, and it was obvious that there had been a castastrophe which she could not long survive. An exploratory laparotomy was done about twenty hours after the onset of the illness.

At operation there was a moderate amount of bloody, peritoneal fluid. Several loops of small intestine were herniated from the anterior side through an opening in the left broad ligament. The mesentery of this portion of bowel was twisted upon itself causing strangulation. The affected intestine was purplish-black, and its peritoneal covering necrotic enough to be partially rubbed off in handling. There was very little bowel distention, the proximal segment being no larger than the distal. A finger was inserted in the broad ligament opening and the tube and ligament severed, thus freeing the incarcerated intestine. The gangrenous area which was sharply demarcated from healthy bowel proved to be 55 cm. in length. This portion was resected, a lateral anastomosis performed, and the abdomen closed without drainage.

The pathological diagnosis was (1) gangrene of small intestine, and (2) thrombosis of mesenteric veins.



FIGS. 1 TO 3. The broad ligament is perforated immediately under the utero-ovarian ligament close to the uterus, and the round ligament drawn through the opening. 3, Fixation of the round ligaments to the posterior surface of the uterus.

Postoperative distention was controlled with a Miller-Abbott tube. The recovery was complete. In the two years since operation there has been no recurrence of the previously periodic attacks, and the patient has enjoyed better health than in many years.

This woman had been operated on fourteen years before by a distinguished New York surgeon. Through a suprapubic paramedian incision, he had performed an appendectomy and "sewed the stomach up a little higher."

Suspecting that a Webster-Baldy procedure had been done, the old records were obtained and this was found to be the case. The fixation had not held, the aperature in the left broad ligament remaining patent. The right was not examined.

A search of the literature indicates that while this is a fairly common operation, its popularity along with other surgery for

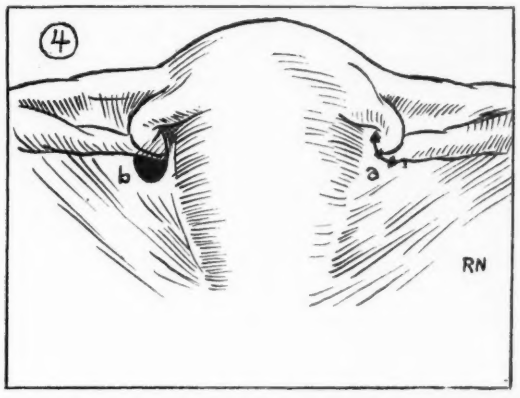


FIG. 4. *a*, The edges of the opening in the broad ligament sutured to the round ligament. *b*, Possible aperture resulting when these sutures are omitted.

retroversion is on the decline. Of the sixteen cases reported with disastrous results, fifteen, including this one, resulted from herniation of small intestine through the perforations in the broad ligament through which the round ligaments had been drawn.

Two reasons have been advanced by other reporters for the presence of these orifices in the broad ligaments. Both were considered to be the result of failure to follow the technic as described by Webster: (1) Not properly closing the openings by stitching their edges to the round ligament; (2) drawing the round ligament through the broad ligament too far lateral to the uterus, thus producing tension on and later laceration of the broad ligament.

Webster,[24] in his 1915 paper, said, "The broad ligament is perforated with a curved forceps immediately under the utero-ovarian ligament close to the uterus." After describing the fixation of the round ligaments to the posterior surface of the uterus he continued, "The next step is important; viz., to close the openings in the broad ligaments stitching their edges to the round ligaments so that no raw surface is left and no chance for the development of a hernia."

The sixteenth case, one of acute intestinal obstruction, seen by the University of

Chicago Clinics[11] thirty days after a Webster-Baldy suspension, was caused by adhesions at the site of the plication of the round ligaments. The broad ligaments were intact.

The case being presented differs from the others in that the broad ligament perforation was present as a result of the failure of the fixation to hold.

Pemberton and Sager[16] reported a case seen twelve years after a Webster-Baldy operation. While doing a myomectomy they discovered bilateral perforations of the broad ligaments where the round had been drawn through. While symptomless, this was potentially just as dangerous as any of the others.

In reviewing these cases, one is impressed with several things: (1) Every case imperiled life and called for emergency surgery. (2) In no instance was a complete preoperative diagnosis made. (3) At least seven had suffered periodic intestinal upsets for one, two, six and twelve years. Four were cured of these attacks by the second operation and the other three patients died. (4) Except for the cases that obstructed in twenty-four and thirty days, the interval was from two to nineteen years, with an average of about ten years.

These observations make one wonder how many unreported disasters there have been following cases of uterine suspension and also how many women may be skirting this disaster at the present time.

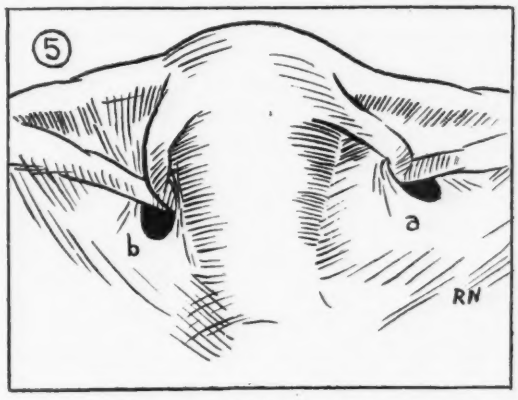


Fig. 5. Openings torn in the broad ligaments when the round ligaments are brought through them too far from either (*a*) the uterus or (*b*) the utero-ovarian ligament. This is thought to happen even when primary sutures have been placed as in Figure 4*a*.

In 1909, after twelve years experience with about one hundred Webster-Baldy operations, Baldy[3] in reviewing the subject wrote, "Retrodisplacements of the uterus are mostly coincident with other lesions, and where such is the case, the symptoms almost universally come from the associated disease." Surgery was recommended

Case	Year Reported	Age	Interval Since W-B Operation	Hernia through Broad Ligament	Other Pathology	Interval Symptoms	Bowel Resection	Result
Richardson	1920	42	2 years	Yes	0	0	0	Recovered
Pemberton and Sager	1929	39	24 days	Yes	0	0	Yes	Recovered
University of Chicago Clinics	1934		30 days	0	Adhesions	4 days		Recovered
Strickler	1935	32		Yes	0	1 year	0	Recovered
Arnold	1938	34	9 years	Yes	0	6 years	Yes	Recovered
Parkes and Karabin	1939	45	15 years	Yes	0	0	Yes	Recovered
Parkes (Hagan)	1939		10 years	Yes	0	0	0	Recovered
Schumann and Beechman	1939	30	3 years	Yes	0	0	0	Recovered
	1939	40	4 years	Yes	0	2 years	Yes	Died
Bowles, H. E	1939	42	16 years	Yes	0	0	0	Recovered
Owen and Kelly	1940	44	19 years	Yes	0	12 years	0	Died
Sakimoto, R. Y	1940	42	Old	Yes	0	0	Yes	Recovered
Bickers, W	1941	31	1½ years	Yes	0	0	0	Recovered
Bickers, W	1941	19	2 years	Yes	0	3 attacks		Recovered
Mayo, Stalker and Miller	1941	47	16 years	Yes	0	Yes	Jejunostomy	Died
Pulrang	1943	45	14 years	Yes	0	12 years	Yes	Recovered

in only carefully selected cases. He repeated this statement in 1915,[4] adding, "nine-tenths of all retroversion operations being done are unnecessary," and "The number being done is limited only by the number of females in the country."

Fig. 6. Herniation of small bowel, from the anterior side, through a perforation in the left broad ligament. The incarcerated segment is gangrenous. This took place twelve years after a Webster-Baldy operation which failed to hold, leaving a residual orifice in the broad ligament.

These statements were made at a Symposium on Operative Treatment of Retroversion of the Uterus held before the Philadelphia Surgical Society in December, 1914. An incredible number of cases were reported, four hundred by one man, nearly a thousand by another, without a single instance of postoperative disaster being mentioned. Hernia was obviously considered since several discussed procedures to prevent its occurrence. At that time about fifty technics had been tried, but those of choice seemed to have been the Webster-Baldy and the Gilliam with its various modifications.

These two continue to be the most frequently used in surgical interference for retroversion, but the incidence of operation is greatly decreased and complications are being reported more frequently.

In an editorial written in 1925 Bevan[5] drawing on his long experience, reviewed three recent cases and recalled fifteen to twenty other cases of intestinal obstructions following fixation operations of the uterus (not the Webster-Baldy type). The purpose of his article was to condemn all operative procedures for retroposition of the uterus as not being justified because of the poor clinical results and the risks involved.

In more recent literature, Michael,[14] in 1936, reported two cases of intestinal obstruction following suspensions of the Gilliam type and cited two more by Peterson of Denmark. Searle[20] reported one following ventrofixation. Schumann and Beecham[21] cited one each by Churtro and Matheson, bringing the total found in the preparation of this paper to ten.

In addition to these reviewed, H. Pohl and Votquenne have reported a strangulated hernia of small intestine after a Baldy-Dartiques operation for retroversion. This appeared in a Belgian Journal of Surgery in 1938, which was unobtainable for review.

In casual conversations at Surgical meetings during the past two years the writer

has heard of three additional unreported cases.

One's conclusion is that this postoperative complication is more prevalent than the medical literature to date would indicate.

SUMMARY

Fifteen cases of postoperative disaster of the Webster-Baldy operation found in the literature have been reviewed and the sixteenth is presented.

Fifteen of these resulted from herniation of small intestine through the broad ligament perforations, one from postoperative adhesions.

The acute episodes occurred on an average of ten years after the Webster-Baldy suspension. Seven patients suffered interval intestinal symptoms.

Most of the case reporters believed that the risk of these intra-abdominal hernias developing could be minimized by carefully following the correct technic.

The case presented resulted from failure of the suspension to hold.

Incidental to this investigation, reports of ten cases of acute intestinal obstruction resulting from other types of uterine suspension operations were uncovered.

In no case was a complete preoperative diagnosis noted.

While the reported incidence of disastrous sequelae is low, these twenty-six recorded cases afford a sufficiently comprehensive study to constitute a serious indictment against operative treatment for retropositions of the uterus.

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FRACTURES OF THE CARPAL NAVICULAR BONE WITHOUT DIRECT TRAUMA

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MUCH has been written concerning fractures of the navicular bone. However, I do not believe that it has been well recognized that fractures of this bone may occur without direct trauma, such as falls and direct blows to the hand.

I have seen two cases in the past eighteen months in which fracture has occurred from sudden twisting of the wrist. The purpose of this paper is to emphasize the importance of re-*x*-raying, within two or three weeks, so-called strains or sprains of the wrist, particularly when the patient complains of severe pain just distal to the wrist joint, and where disability is more marked than one would expect from a simple sprain.

In the first case, the patient was swinging a hammer. In order to avoid hitting someone, he attempted to stop the swing and felt this sudden pain in the wrist. He was *x*-rayed immediately and no fracture was found. He, however, kept complaining of pain in this area and I treated him with diathermy and massage and encouraged him that eventually the wrist would heal.

In order to ally his fears, about three weeks later, he was re-*x*-rayed, on his insistence, and much to my surprise found a well defined fracture with beginning decalcification along the fracture line.

He was immobilized with a non-padded plaster cast, and it took six months of continual immobilization to secure eventual union. The final result was good, except for a slightly diminished power of grip.

In the second case, the patient was lifting a propeller blade from one end of the table to the other end. He slipped on an oily floor and in order to prevent the blade from falling, his wrist was forced backward. He was *x*-rayed immediately and *x*-ray reports came back as being negative. The roentgenologist was told to examine the navicular bone very carefully. The patient continued to complain of pain in his wrist. This time, being on the lookout for this fracture, I did not wait to have the *x*-ray suggested by the patient and *x*-rayed it after two weeks as a routine. This time, not to my surprise, I found a well defined fracture through the body of the navicular bone with beginning separation of the fragments. He was immobilized from July 27, 1943, to September 16, 1943, in a non-padded plaster splint and good union resulted. He was then given a leather wrist gauntlet to continue to wear for another month. At the present writing, the man has good use of the wrist and hand, and is not wearing anything.

COMMENT

These cases have been reported to emphasize the importance of realizing that this bone can be fractured without direct trauma and from sudden flexion of the wrist either dorsally or laterally. It should be routine procedure to *x*-ray all sprains of wrists immediately and then again, routinely, in three weeks, preferably in two weeks. By this time, devascularization will have produced its effects on the blood supply of the bone to make the fracture line visible.

As far as treatment is concerned, a well molded, non-padded splint is the treatment of choice. There must be no motion of the hand in this cast. Very often, in applying these casts, there is some play in the region of the metacarpals where the cast is applied. No matter how slight this play is, it is enough to interfere with the result. These patients are given detailed instructions to report immediately whenever the cast appears even slightly loose. They are also given adhesive tape to rein-

force the distal end of the cast tightly around the metacarpals. This cast should be kept on until there is definite evidence of obliteration of the fracture line. It is not enough to visualize calcification; the fracture line must have disappeared. This as a rule takes a minimum of three months and sometimes takes six months. The patient should be told of this fact, so that he will not be too discouraged. After the cast is removed, if some support is not given, it frequently happens that the fracture reopens. I, therefore, prescribe a leather wrist gauntlet as shown in Fig. 1. This should be worn for approximately three to four weeks.

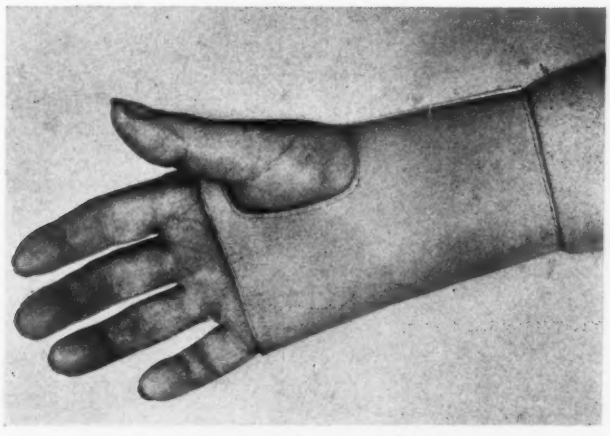

Fig. 1. Leather wrist gauntlet, used following removal of cast in navicular fractures.

The patient should be encouraged to use the hand while in the cast as much as possible, as there is a tendency to osteoporosis of the carpal bones as a result of the long immobilization.

In 90 per cent of the cases, it has been shown that most of these fractures will heal with immobilization alone. As a matter of fact, many of the good results ascribed to drilling and other procedures to promote healing of this fracture, have been explained by some authorities by the prolonged immobilization following these operations.

SUMMARY

1. Two cases are reported of fracture of the carpal navicular bone without direct trauma.

2. Importance of immediate and two or three week follow-up *x*-ray of all sprains is emphasized.

3. Treatment of the fracture is discussed, with importance of prolonged immobilization and follow-up leather wrist gauntlet.

PRIMARY ABDOMINAL PREGNANCY

CASE REPORT

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THE criteria set up for the acceptance of the authenticity of a reported case of primary abdominal pregnancy are (1) normal appearance of tubes, ovaries and broad ligaments; (2) absence of penetration of the space between the broad ligaments by the fimbriated extremity of the tubes; (3) absence of intraligamentary rupture of the tube and (4) lack of evidence of escape of the ova from the uterine cavity. The majority of the cases are not primary implantations on the peritoneum, but are secondary to tubal abortion or ruptured tubal pregnancy.

The case herewith reported appears to conform with requirements and due to the rarity of the condition merits recording.

CASE PEPORT

Mrs. E. L., aged forty-two, a waitress married twenty-four years, had five children living and well. The youngest was sixteen years of age. All deliveries were normal. Her menstrual history began at thirteen years of age and menstrual periods lasted three or four days. No dysmenorrhea or metrorrhagia were complained of. The patient's present illness began on March 14, 1943, when she had her usual menstrual period. Instead of bleeding for three or four days she continued to bleed for twenty-two days. The bleeding was accompanied by pains in her lower abdomen, associated with nausea and a desire to defecate. On three occasions while sitting on the toilet she felt faint and began to perspire freely. Her family noticed a change of color in her face after each one of these episodes. The pains in the lower abdomen were cramp-like and intermittent and would last for one hour and then disappear. The attacks recurred at intervals of a week apart. The patient continued to work as a waitress up to the time that she presented herself for examination.

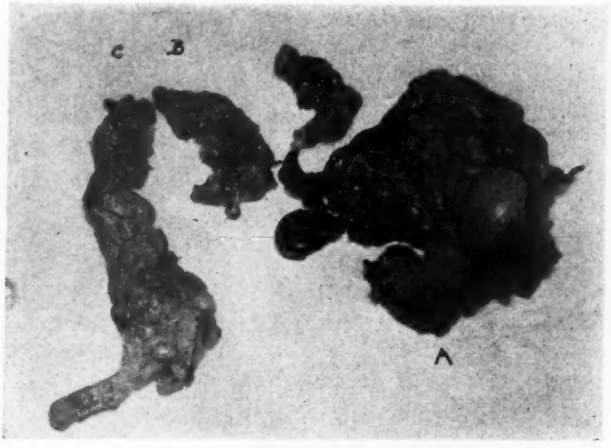

FIG. 1. A, fetus *in situ;* B, appendix epiploicum of sigmoid; C, appendix. B and C were invaded by the chorionic villi.

The patient was fairly well nourished, sallow complexioned and did not appear to be acutely ill. The conjunctivae were pale, pupils were equal and regular and reacted light and accommodation. Ears, nose and throat were essentially negative, blood pressure was 130/85. Heart and lungs were normal. The abdomen showed evidences of a soft distention most pro-

nounced in the lower quadrants. Tenderness was elicited in both quadrants. No evidence of muscle guarding was noted. Pelvic examination revealed a relaxed perineum with slight cystocele and rectocele; the cervix was lacerated and directed anteriorly; the uterus felt enlarged, nodular and irregular. A mass could be felt in the cul-de-sac. This mass was firm, hard, non-tender and tilting of the cervix elicited no complaints of pain. Dark blood was oozing from the uterine canal.

Fig. 2. Fetus removed from sac.

Tentative diagnosis: Fibroid uterus with subperitoneal pedunculated fibroid impacted in the cul-de-sac.

Patient was admitted to the hospital on April 15, 1943, and under gas-oxygen-ether anesthesia the abdominal cavity was entered through a low midline incision. The uterus was enlarged, and showed evidences of numerous small sessile subperitoneal fibroids. Both tubes and ovaries were intact. When an attempt was made to deliver the pelvic ileum from the pelvis it was found to be attached to a large ovoid mass the size of an orange. After freeing the ileum, the mass was dark blue in color, had a glistening surface and was intimately connected with the anterior surface of the rectum. The cecum, appendix and the signoid were likewise adherent to the mass. Extending along the anterior wall of the rectum and attached to the posterior parietal peritoneum was a disc-like brownish tumefaction which peeled off with ease from the peritoneum. As the distal portion of the placenta was reached the cystic sac was opened and the amniotic fluid and fetus escaped into the pelvis. The major part of the placenta, sac and fetus was removed and the oozing was checked by compression. Part of the placenta, which was intimately attached to the anterior rectal wall, was left behind. The abdomen was closed in layers without drainage.

Postoperatively, the patient was given 250 cc. of plasma, and 500 cc. of blood. Intravenous glucose and saline were continued for forty-eight hours. Morphine and pantapon were administered for pain. The postoperative course was stormy for twenty-four hours; the patient suffered from shock and rectal bleeding. The later course was uneventful and the patient left the hospital at the end of sixteen days.

The fetus was 6 inches long, male, with a normal head, eyes, ears, chest, abdomen and extremities. The placenta measured 6 by 7 cm.

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SPONTANEOUS FRACTURE OF THE CALCANEUS*

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CONTRARY to the opinion held by many, a spontaneous or pathological fracture can appear in bone which appears healthy on *x*-ray; at least roentgen study of the bone shows no deviation from the normal, other than the fracture itself. The two chief causes for such a fracture are lues and the so-called "march" fracture. March fracture can be correctly included in this group since the etiological trauma is considered to be very minor in intensity although often repeated.

The following spontaneous or pathological fractures of the calcaneus are described in the literature:

March Fracture. In this type, of which two cases have been reported in recruits, the patient complains of pain in the heel, and the *x*-ray eventually shows a condensation line which clears up after a few weeks of rest.

Fractures in Tabetics. These are of two types: (1) Fracture through the calcaneus in which the posterior portion is displaced away from the major anterior portion with little evidence at repair of the fracture and in which walking can be considered the only cause for this injury. Two such cases are described, both occurring in tabetics. (2) Spontaneous fracture of the calcaneus, giving the appearance of a typical fracture of this bone with loss of the tuber-joint angle, but without the usual trauma. This is described in one patient, occurring in both feet, probably on a luetic basis.

Separation of the Apophysis. Separation of the apophysis is mentioned by Key and Conwell in their textbook on fractures. They advise treatment either by manipulation in plantar flexion, or else by open reduction. They cite no cases, however.

CASE REPORT

The present case is that of W. R., a fifty-four year old female, who, while walking on level pavement, suddenly had a severe pain in the right heel without any known cause. It felt as though "the heel of her shoe had broken off and her leg was sinking into the ground." The ankle immediately began to swell, her ankle and heel became very painful, and she could hardly walk home. This occurred on January 13, 1943.

The patient was seen in the out-patient department two days later, and a marked enlargement of the right heel and ankle was noted. The involved area was red and hot and extremely tender. A fair range of motion of the midtarsal and subastragalar joints was possible but painful. The motion of the ankle joint was extremely painful. The diagnosis of a pathological fracture, probably due to lues, was made, and the patient was admitted as an emergency to the orthopedic service. *X*-rays (Fig. 1) showed a fracture of the apophysis with a displacement upward of the proximal two-thirds.

On a previous admission to the hospital in 1942, the Wassermann report was three plus, and it was found that her husband had died of lues. She was admitted for correction of marked hallux valgus deformities with severe clawing of the other toes of both feet. These were treated by the Keller-Brandes operation for the big toes, and by capsulotomies and phalangectomies of the other toes.

The fractured calcaneus was treated conservatively. The foot was strapped in plantar flexion, and she was kept in bed for about six weeks. At the end of that time, the pain, swelling, and tenderness had practically disappeared. She was allowed to walk and was discharged on March 5th.

After her discharge, she was followed in the out-patient department. Final *x*-rays (Fig. 2) taken in April, about three months after her injury, showed firm union of the displaced

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FIG. 1. Lateral view of foot and ankle five days after injury, showing fracture of the calcaneus with displacement of the upper two-thirds of the apophysis.

FIG. 2. Above: lateral view of the heel three months later, showing firm union of apophysis to body of calcaneus; below: sagittal view of the heel.

apophyseal fragment. At that time, her gait showed weakness of plantar flexion but this was improving.

SUMMARY

A case report is presented of a patient with a spontaneous fracture through the apophysis of the right calcaneus which occurred in a middle-aged woman with a previous history of lues. It was treated conservatively. The available literature includes no case with similar *x*-ray findings.

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POST-TRAUMATIC DEFECT OF THE HUMERAL HEAD

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THIS is a case of an injury to the shoulder in which the immediate finding was a fracture of the greater tuberosity, and subsequent study showed resorption in this area. This is an unusual occurrence; a similar condition has been recorded following dislocation of the shoulder but in this case the defect was the result of a simple fracture of the greater tuberosity.

FIG. 1. Shows the fracture of the greater tuberosity when first seen.

FIG. 2. Three and a half months later. Shows the v-shaped area typical of the grooved defect.

CASE REPORT

A woman, forty years old, was riding on a bus. This vehicle stopped suddenly and her right shoulder struck a protruding bar. Examination a few hours after the accident showed some discoloration of the upper part of the right arm. There was marked limitation of motion, but no evidence of a dislocation of the humeral head. A roentgenogram, taken the following day (Fig. 1) showed a fracture of the greater tuberosity. A shoulder sling was applied and three weeks later active and passive motion of her shoulder was initiated. In spite of the fact that the range of motion increased with time, the patient complained of a dull ache in the affected part. This ache was not ameliorated by the use of salicylates nor by the wearing of a sling. Although physiotherapy was given to the local part, the patient continued to have pain. This symptom increased in severity and, therefore, another roentgenogram (Fig. 2) was made of the shoulder (three and a half months after the accident). This showed a v-shaped area of bone absorption in the region of the greater tuberosity of the humerus.

The patient received physiotherapy and continued wearing the sling for another month. At last examination, six and a half months after the injury, she had almost complete range of painless motion. The diagnosis was comminuted fracture of the greater tuberosity of the right humerus with subsequent resorption.

Similar findings have been explained as follows: (1) congenital anomaly, (2) osteochondritis dissecans, (3) avulsion fracture

with absorption of the fragment, and (4) aseptic necrosis following damage to the blood vessels.

The theory of congenital anomaly must be discarded because this condition would be observed at a very early age without a history of trauma. Almost all congenital anomalies are bilateral and practically all the reported cases in which this defect was observed were unilateral and followed some injury to the shoulder. Osteochondritis dissecans is found in patients of an earlier age group. Avulsion fracture is not an adequate explanation since one would expect to see the displaced fragment immediately after the injury. The theory of aseptic necrosis is untenable as this process does not appear on the roentgenogram for several weeks. Cases showing resorption of the humeral head have been noted on the initial roentgenogram following a single injury.

The explanation that seems most satisfactory is that of Hill and Sachs. They state that this defect is the result of a compression fracture caused by the impinging of the posterolateral surface of the humerus against the anterior rim of the glenoid and is not the late result of the dislocation of the shoulder. They refer to a case in which an autopsy performed twelve hours after the injury showed this defect in the shoulder.

A review of the literature indicates that this defect follows a dislocation of the shoulder, most often an anterior dislocation. One of the explanations of recurrent dislocation of the shoulder is based on this defect near the head of the humerus acquired at the time of the first dislocation. Sometimes this defect is not noted because the anteroposterior roentgenograms are taken in varying degrees of rotation. It is best demonstrated with the arm in marked internal rotation. A tangential view has been suggested; this is obtained by placing the film on top of the shoulder with the tube lateral and below the elbow with the arm internally rotated.

CONCLUSION

A case of fracture of the greater tuberosity of the humerus with subsequent resorption is presented.

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New Instruments

LATERAL TRACTION APPARATUS FOR THE UPPER EXTREMITY*

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THE bed treatment of fractures of the upper extremity is often necessary. Multiple injuries may force the surgeon to employ traction and extension to a bed patient when ambulatory means of fixation would otherwise be used. In addition, other conditions may require traction with arm flexed or extended. Loss of substance of a bone, particularly the clavicle or humerus, may be treated by lateral traction under certain circumstances. An arm amputation stump, a soft tissue contracture or a long standing dislocation may make such traction necessary or desirable.

It is astonishing, therefore, to find that very few hospitals have any standard apparatus for securing lateral traction on the upper extremity. This is particularly true of military hospitals where such apparatus is most often needed. A Jones arm splint is usually available for temporary care, but these excellent splints are unsuited to prolonged bed care of the patient, for they are uncomfortable, insecure, and do not allow for pulley and weight traction. Occasional paralysis of brachial nerves occur from pressure of the arm ring. Pressure necrosis of skin is not uncommon. A few other devices are improvised from time to time as the need arises, but most of them are clumsy and impractical. It seems desirable, then, to introduce a simple and adjustable lateral traction apparatus which can be constructed inexpensively by any small metal working or machine shop. The plans for such a splint are given in detail in Figure 1. The adjustable bed clamps described are suitable for any standard bed frame, but could, of course, be altered for the standard frame in the hospital in which it was to be used.

This splint can be taken apart and stored in very little space. (Fig. 2.) A screw driver is all that is necessary for its assembly, though the back of a knife can be used. The nuts on the pulley bolts can be tightened with the fingers. It can be used with or without the vertical arch as desired and is used conveniently for simple elevation of an infected hand, or to reduce edema about a wound or fracture of the upper extremity. Any portion of the splint can be padded as necessary for the particular use intended. It can be placed with its horizontal platform parallel to the surface of the bed, or raised at an angle of sixty or seventy-five degrees where it is secured by tightening the bed clamps on the braces at the desired level.

With the arm in traction and shoulder resting comfortably on a pillow, beneath which the cross-piece of the splint is placed, the device is very stable. (Fig. 3.) In nearly all cases, however, it has been thought advisable to have a single rope "safety-line" attached to an overhead frame to avoid any sudden shift in position of the splint if it should be bumped by a passer-by. This is not necessary for support, but is used as an added precaution.

The weight of the patient's body is used for countertraction and blocks are placed

* The opinions or assertions contained herein are the private ones of the writer, and are not to be construed as official or as reflecting the views of the Navy Department or the Naval Service at large.

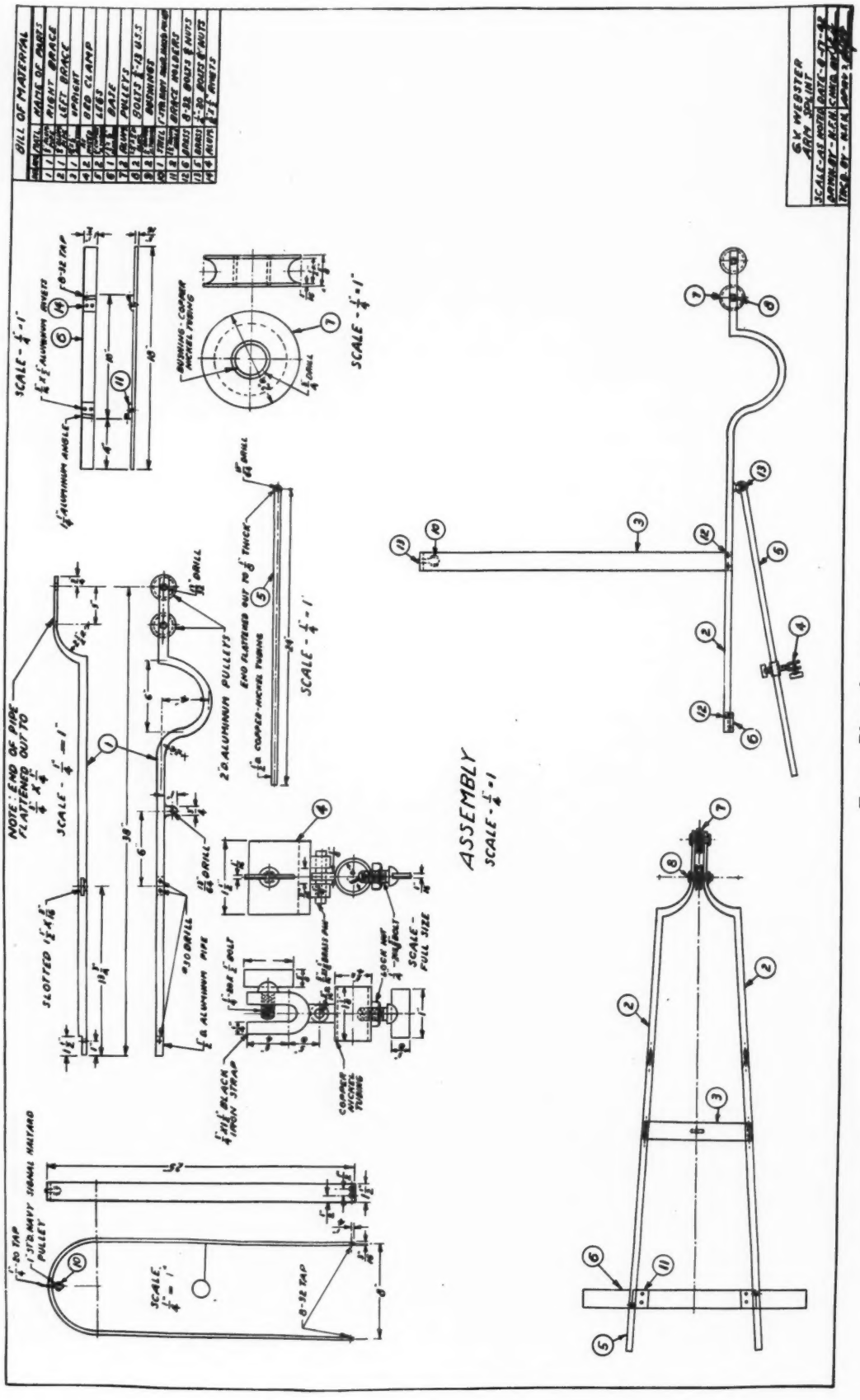

Fig. 1. Plans for apparatus.

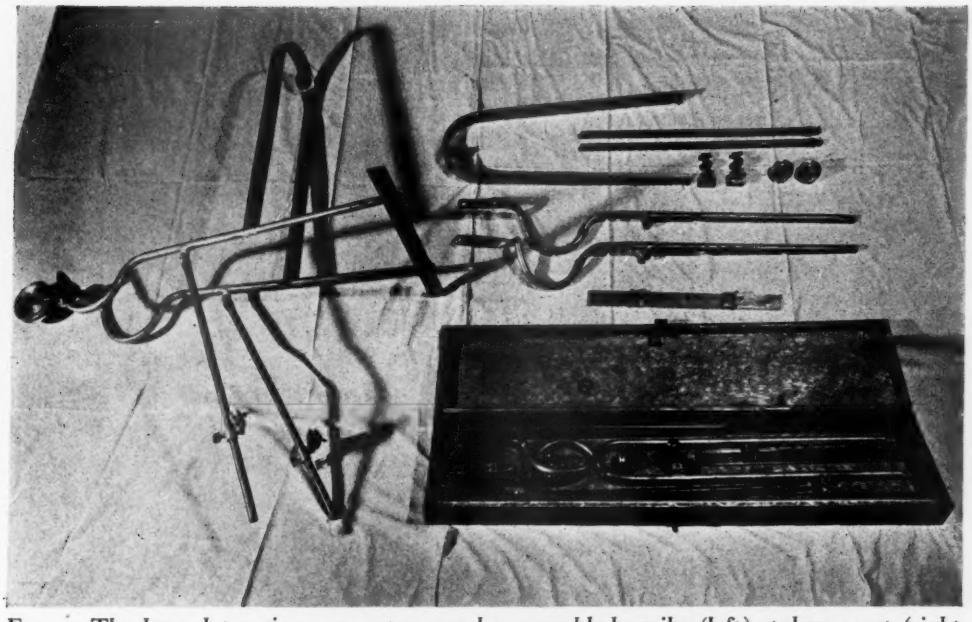

Fig. 2. The lateral traction apparatus can be assembled easily (left), taken apart (right above), or packed neatly in a small metal or wooden box (right below).

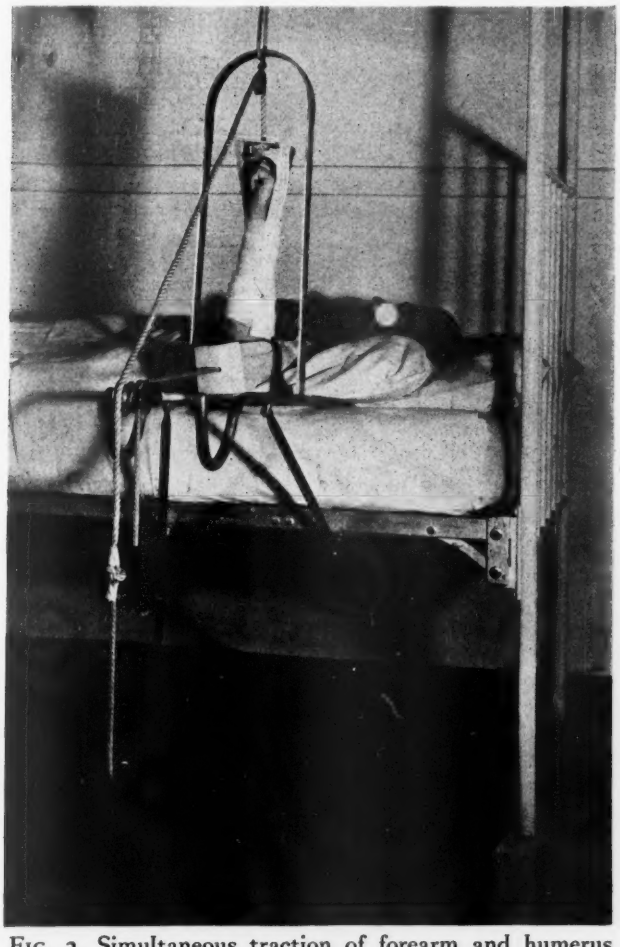

Fig. 3. Simultaneous traction of forearm and humerus for severe overriding of a fractured clavicle. Note the pillow beneath arm and shoulder and the blocks beneath the nearer legs of the bed frame which utilize the body weight for countertraction.

under both lateral legs of the bed frame to tip the bed. (Fig. 3.) Skeletal (Fig. 4) traction can be secured by pins through parts of the splint, open areas can be supported free of any contact with underlying bed-clothing or other support; and

FIG. 4. Traction by means of a Kirschner wire through the metacarpals for a soft tissue contracture (post-traumatic) at the elbow. Here the counter-pressure exerted by the splint on the olecranon is particularly helpful. Active flexion at the elbow is also used in this instance, using the traction weight for muscular opposition.

olecranon, metacarpals or acromion, or these in combination. To facilitate the smooth traction on the extended arm, a "dip" has been made in the terminal portion of the splint. This is most useful when adhesive traction with a spreader board is used, for the board can move freely along a plane slightly below that of the platform of the splint and thus the traction center of the board remains in line with the long axis of the forearm.

Bathing and turning a patient, with the lateral traction device in place, is quite easy but is facilitated if an overhead trapeze bar is available for the other hand to grasp.

The splint has a special usefulness for burns of hand and arm. Wet dressings can be used without soaking the patient's bed. Elevation of the burned member can be secured up to any normally desired level. Pressure dressings, with vaseline or other ointment gauze, can be splinted and supported very comfortably. By padding only in patients with circumferential burns of the arm over a fairly limited area, the additional comfort derived from lack of weight bearing is considerable. Small deep or even Thiersch or thick-split grafts can be treated by open methods and wet dressings with the arm thus supported. Any reasonable degree of elevation is securely maintained.

SUMMARY

Though ambulatory treatment of fractures of the upper extremity is usually the treatment of choice, bed treatment may be necessary and lateral traction required. Other conditions, such as burns, wounds, contractions and dislocations of the hand and arm may require elevation, splinting, or traction. No simple device for lateral traction is readily available in most hospitals and improvised methods may not prove altogether satisfactory. A lateral traction device designed by the author is herewith presented.

THE USE OF A RUBBER STAMP IN RECORDING DATA PERTINENT TO BREAST LESIONS

FRANK H. KIDD, JR., M.D.
Resident Surgeon, The Barnard Free Skin and Cancer Hospital
ST. LOUIS, MISSOURI

THE accompanying breast stamp has been found to be of very definite help in clarifying the records of those patients with breast lesions who present themselves to the Barnard Free Skin and Cancer Hospital.

A written description of the position, size, and shape of a tumor, its attachment to the overlying skin or to the underlying fascia, whether or not there is a "pigskin" appearance in the skin, whether or not there is associated lymph node enlargement, all this and any other notable data should be recorded in every patient's chart. Altogether too frequently some pertinent points are not mentioned. A freshly written record may seem to be all inclusive at the time of recording but, when read at a later date, inadequacies are found. In assembling records for publication one is often impressed by the omission of necessary observations. We, therefore, believe that a diagram can be an important adjunct in both recording and preserving the clinical findings as they appeared at the time of the examination.

The use of a rubber stamp to produce anatomical illustrations is by no means new and the reproduction of an outline of the human breast and axilla by such a means is in itself a thing which has been done for years. We wish to make no claim as to the originality of this practice. We only offer a stamp which we think lends itself nicely to graphic illustration of most of the features which should be recorded as a part of the patient's case history.

Dr. William E. Leighton, chief of the Breast-Extremity Service, has long been aware of the failure of examiners to notice, or at least to record, the depth of a lesion within the breast substance. He suggested that a diagram should embrace both the profile and frontal views of the breast so that the lesion could be localized in depth as well as to a particular quadrant. This point was borne in mind when the stamp was being designed.

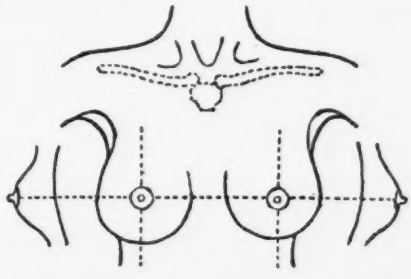

FIG. 1. The anterior thorax and the lower cervical regions are shown. Each breast is illustrated in frontal and profile views. The frontal view is divided into five segments (upper-outer, upper-inner, lower-outer, lower-inner and areolar). The profile view is divided into upper and lower halves. The axillary and supraclavicular fossae are shown.

It is a common practice to divide the breast into four quadrants such as upper-outer, lower-inner, etc. In addition to these a fifth subdivision, viz., the areolar area, is included. Since a certain number of intraductal papillomas are confined to a lactiferous sinus, it is wise to include such a subdivision as these could not be said to lie within one of the four quadrants.

A simple, diagrammatic sketch is the most useful medium for inking in one or more lesions. It is recognized that there are large, medium and small sized breasts and there is a pronounced variation in their shape. An outline was chosen which could be used effectively in the greatest number of cases. As both breasts are frequently

involved, especially in cases of chronic cystic mastitis, it was decided to include both on one stamp. By including both breasts the problem of labeling left and right is obviated. The presence of palpable lymph nodes is a significant finding and should be depicted so the axillary and supraclavicular fossae are included.

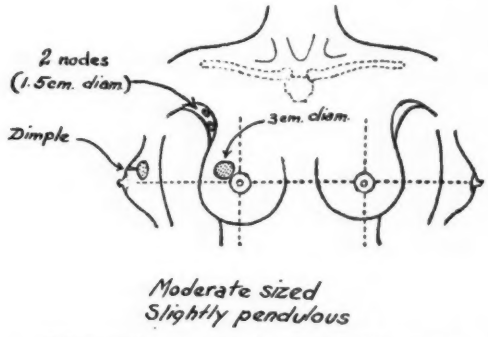

Fig. 2. Illustrating a mass (3 cm. in diameter) in the upper-outer quadrant of a moderate sized, slightly pendulous right breast, with axillary lymph node metastasis and dimpling of the skin.

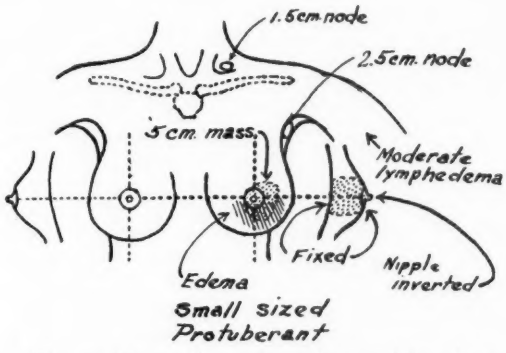

Fig. 3. Illustrating a large inoperable subareolar and adjacent quadrants mass (5 cm. in diameter) of the left breast. Other important data illustrated: inverted nipple, deep and superficial fixation of the mass, skin edema, axillary and supraclavicular metastatic lymph nodes, moderate lymphedema of the arm and the size and shape of the breast.

Figure 1 shows the evolved stamp. All features are included which were believed to be necessary. Figures 2 and 3 show the stamp as it might be used.

It is recognized that but little artistic ability is needed to ink in the apparent size and location of all masses. Fixation of a tumor to skin or to underlying tissue may be easily demonstrated by the use of the profile view. Dimpling of the skin may be indicated by drawing an arrow from the label to the point where it occurs. In the same way satellite tumor nodules and discharges from the nipple may be shown. Inflammatory zones, ulcerations and areas of edema (either localized "pigskin" of the breast or lymphedema of the arm) may be depicted by stippling, hatching, cross-hatching or, in the case of a swollen arm, the outline of the extremity may be drawn in. The presence of axillary or supraclavicular lymph nodes is recorded by making a dot in the correct location and indicating the clinical size by corresponding labels. (Stout believes that the clinical measurement of axillary lymph nodes is important, especially in evaluating the operability of the patient.) Below the illustration should be written terms descriptive of size and shape, i.e., small and atrophic or large and pendulous.

REFERENCE

Stout, A. P. Clinical diagnosis of cancer of the breast. *J. Missouri M. A.*, 39: 301, 1942.

SIMPLE LOCKING DEVICE FOR FURNISS-CLUTE CLAMP*

EARL O. LATIMER, M.D.
Assistant Professor of Surgery, Northwestern University Medical School; Attending Surgeon, Wesley Memorial Hospital
CHICAGO, ILLINOIS

CLOSING the duodenal stump during a gastric resection is extremely important and many methods of closure have been described. The difficulties that sometimes arise in attempting this closure are attested to by the many articles written about and devices made to facilitate this procedure.

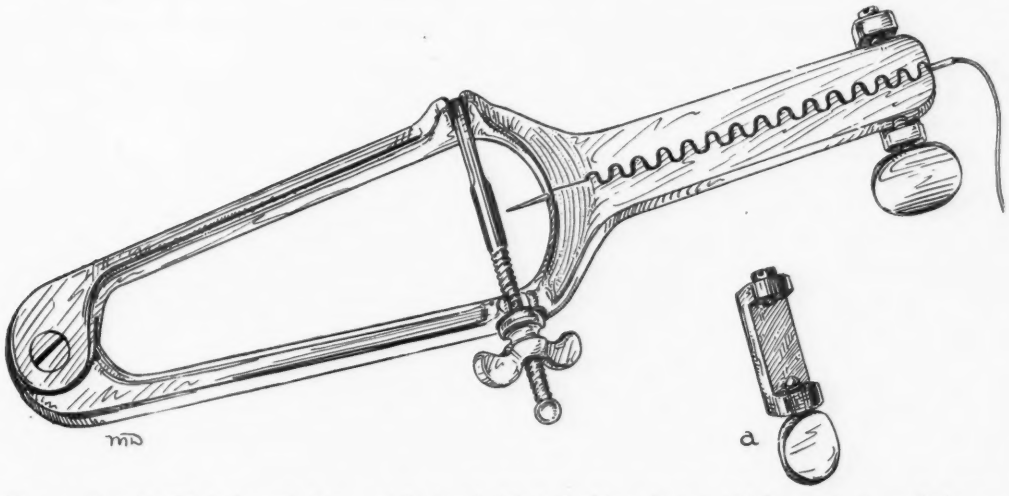

FIG. 1. Furniss-Clute bowel clamp with simple blade locking device which evenly interdigitates blades properly shirring bowel for pinning. Insert (*a*) shows details of lock and simplicity of its construction.

My preference for the routine closing of the duodenal stump is to use the Furniss-Clute clamp which crushes the duodenum and permits the needle with swedged on suture to be inserted through the bowel before the bowel is cut and the clamp removed. By using this type of clamp, more of the duodenum can be safely removed than if a Payr or similar clamp is used.

There is one definite disadvantage of the Furniss-Clute clamp, namely, that the leverage is applied proximal to the interdigitating blades which, therefore, do not always properly shirr the tissues between them for proper placing of the needle. This criticism has been expressed by many surgeons who have tried this instrument. This fault is not present in the original Furniss clamp but the original clamp permits the needle to be inserted from one end only and this limits its field of usefulness. To overcome this, the Furniss-McClure clamp was made for duodenal closure but this is not as easily handled as the Furniss-Clute clamp and its usefulness is limited.

To overcome the objectionable feature of the incomplete closing of the jaws of the Furniss-Clute clamp, I had a simple clamp lock made to be placed on the end of the clamp after the clamp had been placed and tightened over the duodenum. This lock* consists of a single piece of

* This simple locking device was made for me by V. Mueller of Chicago.

* From the Division of Surgery, Northwestern University Medical School, and the Department of Surgery, Wesley Memorial Hospital, Chicago.

metal, slightly greater than the width of the closed blades of the clamp, with each end turned at right angles to the body of the clamp lock. Through the center of each end of the clamp lock is placed a set screw, which fits into a small indentation that has been drilled near the end of each blade of the clamp. One of the set screws is winged so that it may be tightened by hand, bringing the blades of the clamp together evenly throughout their entire length, Fig. 1. After the needle is inserted through the bowel, the tightening device is removed, the clamp opened in the usual manner and the bowel closure continued.

This clamp lock will greatly increase the ease of insertion of the needle through the shirred bowel contained in the Furniss-Clute clamp and remove the danger of the needle not properly pinning the bowel. By its use on the Furniss-Clute clamp, this clamp has a wide range of usefulness in bowel surgery and has all of the advantages of the original Furniss clamp with a greatly increased field of application.

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From "Minor Surgery," edited by Humphry Rolleston and Alan Moncrieff (Philosophical Library).

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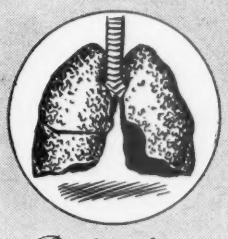

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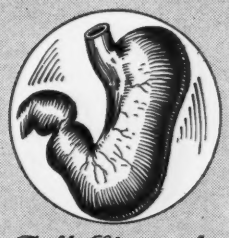

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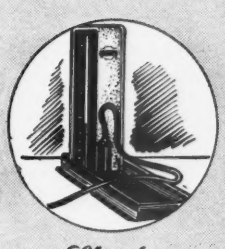

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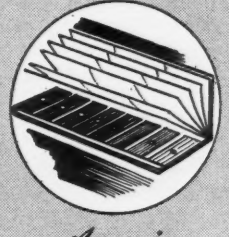

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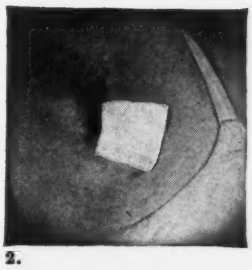

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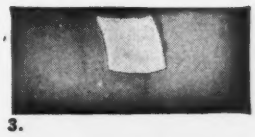

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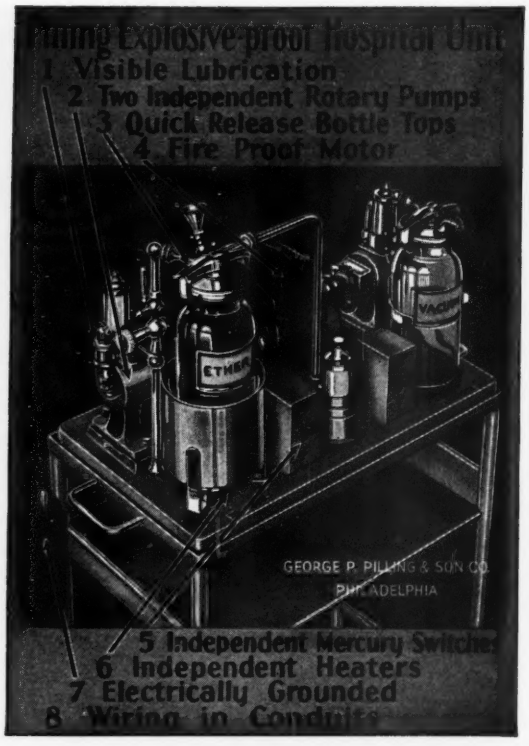

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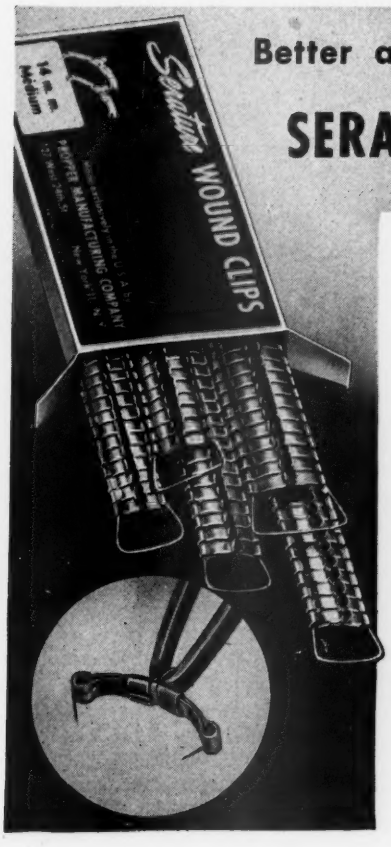

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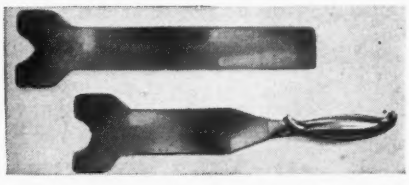
Illustration demonstrating the use of this new retractor, with the notched end exposing the cystic and common bile ducts, portal vein and the hepatic artery.

THE retractor herewith illustrated was designed to give a maximum exposure of the biliary ducts with minimum effort on the part of the assistant. From the standpoint of the assistant, it is almost foolproof.

The retractor is made of the same material as the so-called "ribbon retractors." It is, therefore, pliable and can be bent to adjust itself to any curve in securing exposure of the ducts. It is 12¼ inches in length, 3⅛ inches wide at its broadest end and 1¾ inches at the narrowest end. The broad end is notched so that the retractor may rest down over the ducts without injury to them, and at the same time secure the greatest possible amount of exposure.

No. 3827 WALKER'S GALL BLADDER RETRACTOR, ea. $6.50

No. 3828 WALKER'S GALL BLADDER RETRACTOR WITH YOUNG'S HANDLE.....ea. $8.50



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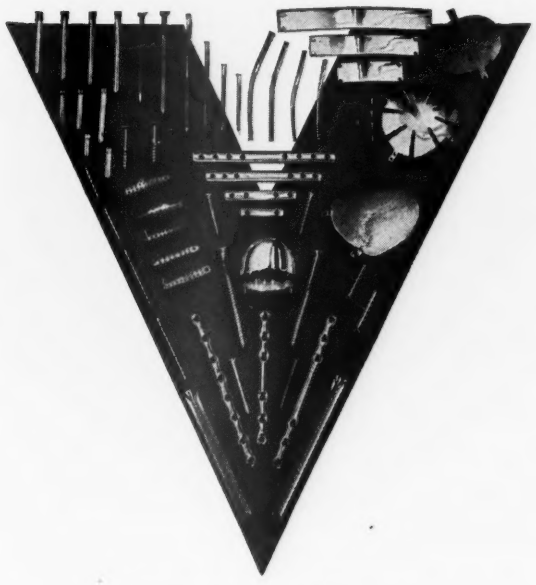

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*Campbell, W. C. and Speed, J. S., Annals of Surgery, 110-1. July, 1939. • Berry, H. C., Journal of Arkansas State Dental Association, 10-2. June, 1939. • Strock, A. E., American Journal of Orthodontics & Oral Surgery, 25-5. May, 1939. • Doherty, W. B., American Journal of Ophthalmology, 22-4. April, 1939. • Smith-Petersen, M. N., The Journal of Bone & Joint Surgery, 21-2, April, 1939. • Claflin, R. S., American Journal of Orthodontics & Oral Surgery, 25-1. January, 1939. • Hopkins, H. H. and Zuck, F. N., Medical Bulletin of Veterans' Administration, 15-3. January, 1939. • Venable, C. S. and Stuck, W. G., Journal of American Medical Association, 11-15. October 8, 1938.

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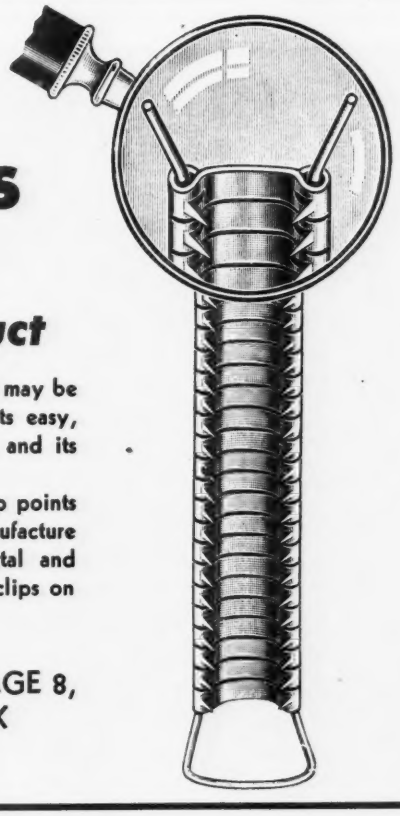

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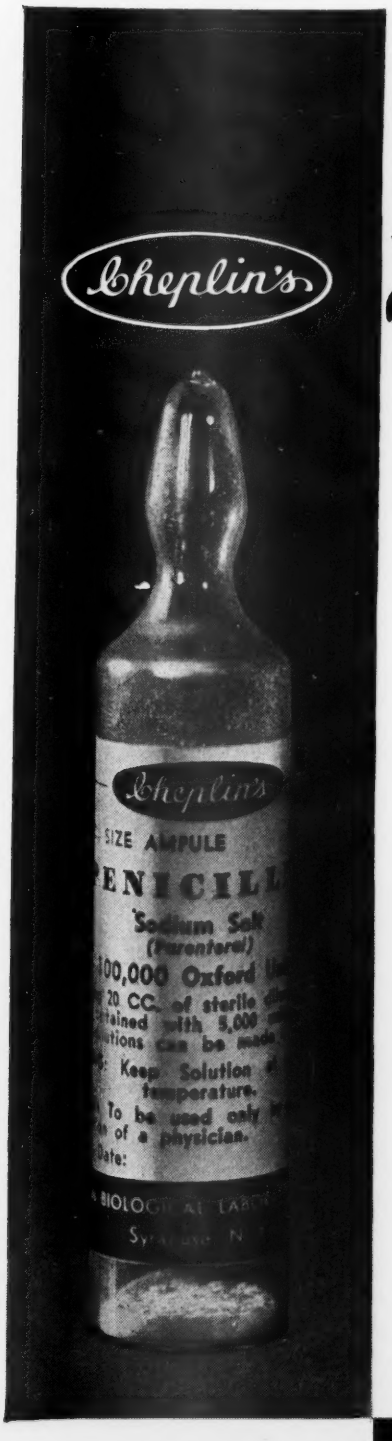

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Speedy correction of postsurgical anemia is a valuable contribution to rapid recovery. Through unfavorable influence on gastric secretion, on appetite, and on the sense of well-being, anemia interferes with food intake at the very time when nutrition is of paramount importance.

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EACH CAPSULE CONTAINS:

Ferrous Sulfate	4.5 gr.
Vitamin A	5000 U.S.P. Units
Vitamin B_1 (1 mg.)	333 U.S.P. Units
Vitamin D	500 U.S.P. Units
Vitamin G (0.50 mg.)	500 micrograms

together with liver concentrate (vitamin fraction), derived from 4 grams of fresh liver, and dried brewers yeast.

In the postsurgical period, when the speed of recovery depends so largely on the patient's nutritional state, Noviplex proves a valuable means of augmenting the dietary. It provides the essential components of the B-complex in approximately the proportions required by the human organism. Since it is largely derived from high potency yeast concentrate, Noviplex provides all the naturally occurring factors, including choline, inositol, and biotin.

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Niacinamide	8.0 mg.
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plus all other factors naturally occurring in yeast concentrate. Noviplex is supplied in bottles of 100 and 500 capsules.

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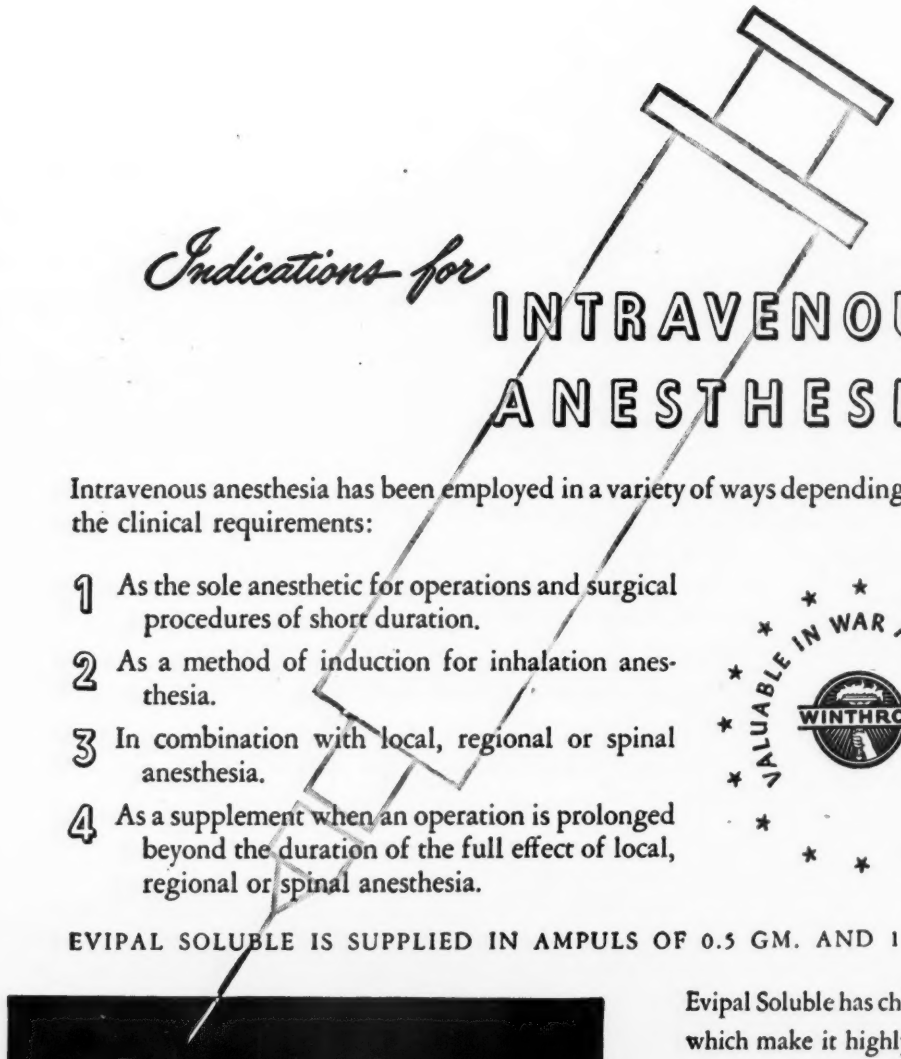

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Intravenous anesthesia has been employed in a variety of ways depending upon the clinical requirements:

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"Evipal" Reg. U. S. Pat. Off. & Canada
Brand of HEXOBARBITAL SOLUBLE
(Sodium salt of N-methylcyclohexenylmethyl barbituric acid)
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Evipal Soluble has characteristics which make it highly useful for inducing these various types of anesthesia of short duration. Proper dosage gives deep relaxation of voluntary muscles, yet quick awakening and recovery, generally after twenty or thirty minutes.

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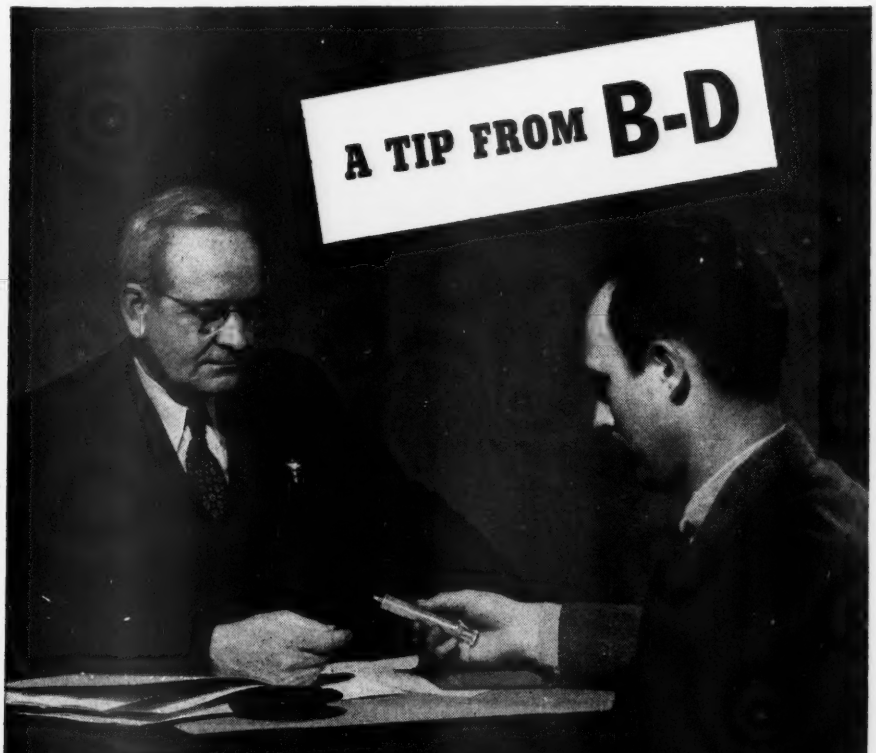
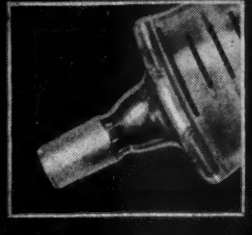


Over half of ordinary all-glass syringes meet a premature end because of unnecessary tip breakage. This represents a needless waste of man-hours, material and money. Waste we can ill afford in time of war.

Some time ago B-D engineers made an interesting discovery: All syringe tips must be ground to seat the needle hub securely. On close examination, however, it was noticed that a circular scratch, fracturing the skin of the glass, was invariably left by the end of the grinding tool. Tips broke at this scratch, just as a window pane breaks at the scratch-line made by a glazier's tool. And so B-D tips were redesigned with a recess of unground glass just above the tip. Now, the end of the grinding tool revolves harmlessly in space.



Result—a tip approximately twice as strong and B-D Syringes that give you the longest possible life of useful trouble-free service.

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Made for the Profession

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CRITICAL ACCIDENT STUDY CONFIRMS THE NEED FOR *Adequate Breakfast*

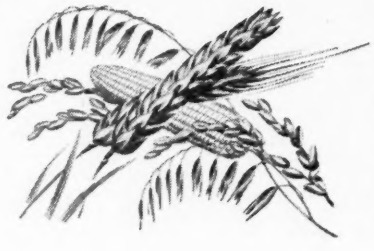
The recommendation, so widely advanced by nutritionists and medical authorities—that breakfast should provide from ¼ to ⅓ of the day's total food intake—gains added substantiation through analysis of 1009 consecutive accidents at an ordnance depot.*

The period, during which these accidents occurred, July 19, 1943 through November 7, 1943, was most favorable from a weather standpoint, since winter tends to increase accident rates. The study was not concerned with the immediate cause of each accident, but rather with predisposing factors.

Four important conclusions were reached: (1) the accident rate for women is lower than for men; (2) it is higher in young persons; (3) the frequency of accidents varies during the course of the work period; (4) the greatest number of accidents occurs between 11 A.M. and 12 noon, the last hour before lunch.

One of the reasons given for this morning peak accident incidence is that little or no breakfast is eaten by the workers. Since work starts at 7 A. M., an average of 6 hours elapses between the skimpy morning meal and the noon meal. During these hours the accident rate rises progressively, reaching peak during the last hour of the morning period. Increasing hunger leads to nervousness, impaired judgment, lessened concentration on the work. Diminishing glycogen reserves hasten the onset of fatigue, an important factor in accident rates.

From this study it may well be concluded that the nutritionally adequate breakfast should prove a valuable adjuvant in lowering accident rates. As a basic breakfast pattern, nutritionists recommend fruit, cereal, milk, bread and butter, providing not only about 600 calories, but notable amounts of all essential nutrients as well. If more is required, this breakfast is easily augmented by the addition of other suitable foods.



**Mann, J.: Analysis of 1009 Consecutive Accident Cases at One Ordnance Depot, Indust. Med. 13:368 (May) 1944.*

The presence of this seal indicates that all nutritional statements in this advertisement have been found acceptable by the Council on Foods and Nutrition of the American Medical Association.

CEREAL INSTITUTE, INC.
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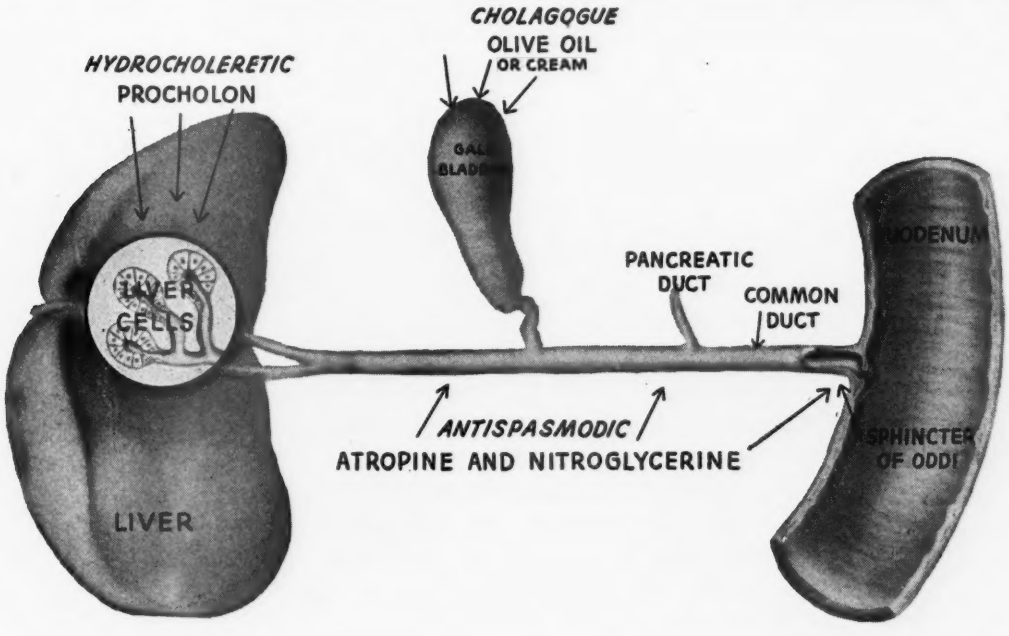
To Flush the *Bile Passages*



In biliary stasis, whether associated with inflammation of the gall bladder or biliary ducts, or with liver insufficiency, the problem of securing free flow of bile can be met by utilizing the hydrocholeretic activity of unconjugated dehydrocholic acid—Procholon.*

Procholon is highly efficient in promoting the flow of low-viscosity bile.[1] The drainage of the biliary ducts is encouraged, plugs of mucus and debris are swept onward. This mechanical action helps to check ascending infection of the biliary tract. Improvement in liver function has been observed[2] following administration of dehydrocholic acid.

Procholon is available for oral administration as 3¾-grain (0.25 Gm.) tablets in bottles of 25, 100, and 500.

[1] Goldman, L., and Bell, H. G.: *J. A. M. A.* 17:582, Nov. 8, 1941.

[2] Grodins, F. S.; Osborne, S. L.; Ivy, A. C., and Goldman, L.: *Am. J. Physiol.* 132:375, March 1941.

* "Procholon" (Reg. U. S. Pat. Off.) is a trade-mark of E. R. Squibb & Sons.

For literature write to Professional Service Dept., 745 Fifth Avenue, New York 22, N. Y.

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Human sperm, in contact with hostile genital secretions, apparently suffer early immobilization—particularly if the seminal picture is characterized by a low sperm count and feeble motility.*

In clinical tests, a pre-coital douche of Nutri-Sal (a physiologic glucose douche powder) has been found to promote fertility in many stubborn cases free from detectable deficiencies or pathogenies. In temporarily relieving local incompatability, it also supplies the nutrient glucose, metabolized by the sperm for motile energy.

The results obtained with Nutri-Sal may obviate the necessity for more elaborate diagnostic procedures. Ortho Products, Inc., Linden, N. J.

*MacLeod and Hotchkiss, Amer. J. Obst. & Gynec., Sept., 1943

Nutri-Sal

FOR USE IN SELECTED CASES OF INFERTILITY

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The American Journal of Surgery

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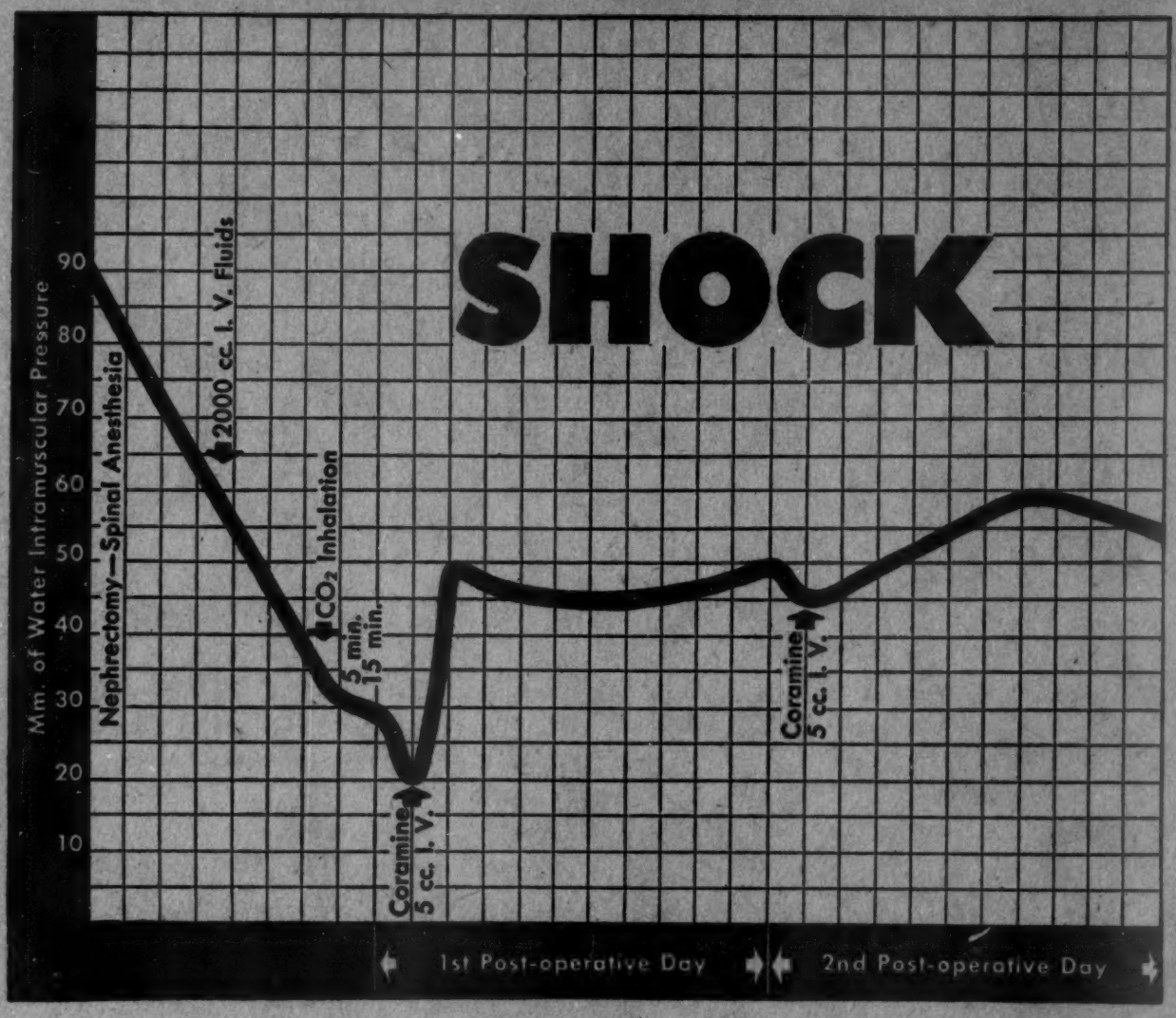

SHOCK is a complex syndrome having many causes and presenting many symptoms. Recent research[1] has demonstrated that in post-operative and post-anesthetic shock *intramuscular pressure drops before venous pressure fails.* This intramuscular pressure is of greatest importance in maintaining peripheral circulation and venous pressure is returned to normal by a restoration of intramuscular pressure.

CORAMINE,* of all the drugs tested, was found to promptly and spectacularly increase intramuscular pressure to normal. It was used intravenously in doses of 5-10 cc.

[1]Gunther, Lewis, Engelberg, Hyman and Strauss, Ludwig., INTRAMUSCULAR PRESSURE, Am. J. Med. Sci., 204, 266-283, Aug., 1942.

CORAMINE

COMBATS SHOCK

AMPULS **LIQUID**

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